The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. V, No. 11 November, 1914

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The Journal of Heredity is published monthly by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Price of single copies, 25 cents.

Entered as second-class matter August 27, 1912, at the postoffice at Washington, D. C., under the act of August 24, 1912. Contents copyrighted 1914 by the American Genetic Association. Reproduction of articles or parts of articles permitted provided proper credit is given to author and to the Journal of Heredity (Organ of the American Genetic Association). Washington, D. C.

Date of issue of this number, October 25, 1914.

DESCENDANTS OF THE EUROPEAN UR OR AUROCHS

Young Chillingham Park cattle, lately presented to the Royal Zoological Society, London. They are considered to be nearly direct descendants of the now extinct European wild ox, which was still found in isolated localities until three or four centuries ago. These Chillingham cattle are semi-albinoes; dark calves appear from time to time and are weeded out. They show a remarkable diminution in size from that of the ur (*Bos taurus primigenius*), due, Darwin thought, to the inbreeding to which they have been subjected for centuries. That this inbreeding has not resulted more disastrously to the stock is probably accounted for by the stringent selection, through combats for supremacy among the males. Photograph from Paul Thompson. (Frontispiece.)

ARYAN AGRICULTURE

Most Important Plant and Animal Products of Europe Indigenous—Wheat and Barley Cultivated 50,000 or More Years Ago—Horse the Latest of the Important Animals to be Domesticated—Origin of the Plow.[1]

PRIVATDOZENT DR. DETTWEILER
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UP TO quite recently, it would hardly have been possible to write on the theme I have chosen today, "The Beginnings of Agriculture and Animal Husbandry among the Indo-Germans." For it used to be taken for granted that Europe with its Indo-German population received all its culture from Rome and Greece, or from the Babylonian Orient, and so it was quite useless to concern one's self over such a problem as I have just stated. The northern European population passed for raw, ignorant, wholly uncivilized—in a word, they were barbarians, to whom the higher civilization of the south and east first brought the light of progress. Nay, not only was the culture supposed to have been imported from the outside, but the population itself was held to have immigrated from Asia.

On all these questions the last two or three decades have caused many reversals of position. Just as natural science is today based on the idea of evolution, so has the idea gradually gained ground that the population of Europe developed independently on its own ground with its own culture—more, that these have an antiquity surpassing anything we know of Babylon or Egypt. Today it is admitted—except by a few—that the original home of the primitive European population, the Indo-Germans, is not Asia but Northern Europe, that they developed their culture there in the late Stone Age, and that they then dispersed in their wanderings to the south and east, as far as India. I can not now enter into the details of this question. I must ask you simply to accept it as a fact, that the standpoint above sketched is the correct one. According to it the coast of the East Sea, perhaps with Mecklenburg as its central point, is to be considered the original home of the Indo-Germans. But even here, they were *immigrants* at a relatively late day, and perhaps are merely descendants of the people of the Stone Age, who lived during the Glacial Period in southern France and Spain, perhaps also on the northern coast of Africa. In this connection it must not be forgotten that during the Ice Age the climate in that region was milder—that is, cooler—than it is at present. It was only after the ice had melted away in our latitude that man ventured into the north.

CROPS OF THE LAKE-DWELLERS.

In order to have some secure standpoint from which to handle our none too simple data, it seems necessary to take a definite cross-section of history, and I shall therefore take the so-called Age of the Lake-dwellings. It is fairly known, even in details, is remote enough to be included in the prehistoric period, and yet has been so thoroughly investigated that one can form a tolerably clear picture of it. Its culture belongs to the so-called Neolithic or later Stone Age, extending perhaps up into the Bronze Age, that is, about 2000 to 4000 years before Christ.

I shall limit myself to a consideration of the agriculture of this period.

[1] Address delivered before the Dozentenverein of Rostock; translated (and slightly abridged) from the Illustrierte Landwirtschaftliche Zeitung, 32 Jahrgang, No. 81, p. 745, Berlin, 9 Oktober, 1912.

The lake-dwellers of Switzerland cultivated, according to Braungart, the following kinds of plants:

1. The short-eared, six-rowed barley, *Hordeum sanctum* of the ancients, which was grown in the Alps up to recent times.

2. The thick-eared, six-rowed barley, *Hordeum hexastichon* L., var. *densum*, with large ears and kernels.

3. Two-rowed barley, *Hordeum distichon*.

4. Small lake-dwelling wheat, *Triticum vulgare antiquorum*.

5. The true Binkel wheat, *Triticum vulgare compactum*, which is even today grown in isolated localities in the Alps.

6. Egyptian or English wheat, *Triticum turgidum*, L. It is today widespread in many varieties.

7. Emmer, *Triticum amylium*, Seringe, T. *dicoccum*, Sch., a thick-eared, awnless, unique species, grown in its original form in the Tyrol as late as 40 years ago, but seeming now to have changed.

8. One-grained wheat or Einkorn, *Triticum monococcum*, L., grown in the transition period between the Stone and Bronze Ages, perhaps along with spelt (*Triticum spelta*, L.). Today it is grown only in scattered regions of the Tyrol.

9. Meadow (common), millet, *Panicum miliaceum*, L.

10. Club millet, *Panicum italicum*, L.

11. Flax, not that known today (*Linum usitatissimum*), but the type which still grows wild in Greece, *L. angustifolium*, L.

Far from these lake dwellings, in the little village of Gleichberg, near Römhild, at the southern edge of the Thuringian forest, under a wall 10 meters high on an old fireplace, there was uncovered in 1906 an important find, with remains of the oldest Bronze Age, which contained the following:

1. Einkorn wheat. 2. Spelt, which is grown there even to this day. 3. Binkel wheat. 4. Small lake-dwelling wheat. 5. Small lake-dwelling barley. 6. The smallest (Celtic) type of vetch (*Vicia faba*, L., var. *altica nana*, Heer.) 7. Peas, *Pisum sativum*. 8. Poppy, *Papaver somniferum*, var, *antiquum* Exceptionally large seeds, apparently cultivated. 9. Apple seeds (?).

That *Triticum turgidum* was lacking, is explained by the climate.

PROOFS OF HIGH CULTURE.

At various points in Württemberg (at Gross Pretach near Heilbronn and at Heutingsheim near Ludwigsburg) whole villages belonging to the late Stone Age have been excavated and have shown a high degree of culture—that is, well developed agriculture and animal husband y. There can no longer be any doubt that a well-directed search would unearth many more proofs of active life in the prehistoric period in that region. That they are still lacking is explained by the newness of the idea and the little endeavor that has been made to confirm it. We have much better information about the early years of the peoples of Asia, wholly unrelated to us, than we have about our own predecessors in Germany.

But the data already accumulated show this at least, that in the later Stone Age a rather highly developed culture with the cultivation of food plants and the keeping of domestic animals, existed. But where did it come from? Its mere existence does not prove that it grew up on the soil, and is not an Asiatic importation.

To get such proof, we must go still farther back and explore the Paleolithic or old Stone Age.

The early discoveries showed us a great gap—the so-called *Hiatus*—between old and new Stone Ages, which favored the theory that the population had entirely changed in that period, because no signs of transition could be found. Later discoveries have revealed the transition. The number of those who have rejected the idea of a change in the population, and have insisted on a persistent evolution of the same stock, is therefore augmented. Each day, almost, brings more evidence to their support, and it seems as if the time is not far distant when the gap will be closed.

Nevertheless, in the field that interests us—agriculture—there is a great gap still. For while the men of the new Stone Age had almost all our present-

WILD AND CULTIVATED WHEAT

At the left, seeds of the wild wheat of Palestine, which is thought by some authors to represent the ancestral form of the present cultivated wheats. In the center is a large-seeded variation of this wild wheat, which was produced at Bard, California; on the right is shown, for comparison, seeds of the Sonora wheat, the one ordinarily grown in the southwest United States at the present day. The Palestinian wheat (*Triticum hermonis*) has adaptations for cross-pollination, whereas the cultivated varieties at present depend almost invariably on self-fertilization. Photograph from O. F. Cook, enlarged about one-fourth. (Fig. 1.)

day domestic animals, our most important field products and—as we shall soon see—our farm implements, the men of the old Stone Age had as domestic animals at most the dog and perhaps the reindeer, and among garden products had only two or—if you like—three kinds: barley and wheat, but the latter in two forms—*Triticum polonicum*, L., which is still cultivated at the present day in the Spanish province of Galicia, and owes its name to a geographical error of Linnaeus; and spelt.

Recent discoveries have thrown valuable light on the upper middle Paleolithic age, the Age of Reindeer. They come from caves in the Pyrenees mountains near Lourdes, and consist of carvings on reindeer horns, unmistakable in their execution. Further, in the cave of Lorthet, belonging to a late part of the same epoch, there was found a carving on slate, which depicted winter barley such as is even yet grown in that locality.

Means of preparing food at that period have not yet been found. Perhaps people ate their grains roasted. This condition exists throughout the transition period from the old to the new Stone Age; and from that period barley and wheat grains have been found, not only in southern France, but also in the mounds of mussel shells along the coast of Denmark.

I want to make it plain that in the Paleolithic age—that is, some 50,000 years ago—man must have had some kind of an art of agriculture. That he must have possessed a relatively high degree of culture is demonstrated by the wonderful fidelity to nature shown in his engravings on cavern walls.

Whether his cultivation of cereals was done with a hoe, as we cultivate garden-stuff, or whether it was done in some other manner, is a question of secondary importance. The point of real importance is that in such a relatively distant period there was any agriculture at all.

ORIGIN OF CULTIVATED WHEAT.

Where did his plants come from?

It is evident that the men of the old Stone Age must have made use of plants that grew wild around them, whose seeds or fruits they gathered, and whose value was generally known. Such ancestral forms have been definitely identified, in our time, only in Palestine, where about 30 years ago

Koernicke of Poppelsdorf found wild forms of wheat and barley. Lately Aaronsohn has confirmed these discoveries.[2] The two forms look remarkably alike, and Braungart thought he had discovered, in Alpine mutations, the transitions between them. Aside from that, North Africa yields an indigenous wild barley. Apparently the ancestral home of this plant is in the Mediterranean region, a fact that bears witness to the antiquity of its culture and the close connections between the Paleolithic cave men and the Indo-Germans.

Rye and oats can not be found with certainty until the Bronze Age. Whence the rye came is an unsolved question. Hirt thinks, as a result of certain indications, that rye was known to the Indo-Germans even earlier than this. Oats are European in their origin, and in the form of the so-called wild or "fly" oats are a common weed.

Studies in comparative philology have, according to Hoops, shown that the Indo-Germans had names *in common*, for the following things and ideas relating to agriculture: among cereals, barley, spelt, wheat and millet (this appears to be the third oldest crop, thus presupposing a culture in high antiquity); grains, garden bed, couch-grass (*Triticum repens*), rye-grass (as a weed). Chaff, furrow, arable land, scythe, sickel. Broom. Meal, to grind in a mortar, to pound, to grind between stones, millstone, handmill, mill.

Of these words "furrow" and "garden bed" extend only into the Armenian; the others are common, and must therefore have been the property of the original population before its first great separation. They give the starting point for an evaluation of the primitive culture. Gardening with a hoe must at that time have been outgrown; we find ourselves in the presence of a real agriculture—otherwise words for plow, furrow and arable land would not have been in use. Everything points back to a time much more remote than we have been accustomed to take into consideration.

Flax, peas, beans, potherbs, are later acquisitions, like rye and oats.

Barley seems to have been the earliest crop; barleycorns were used as measures of weight and length by the primitive Indo-German peoples.

The question at once presents itself, whether the agricultural implements and skill of the Indo-Germans offer a means of determining at what period their separation took place. Braungart has attempted to solve this question, and seems to me to have succeeded.

EVOLUTION OF THE PLOW.

He reviews, in a long and acute work, all the agricultural implements which he has seen either in the original or in model or picture, and reaches the following conclusions:

1. The hand implements, and the hand-plow evolved from them, are of Indo-German origin, and must have been developed before the emigration to Asia of the multitudes which later figure as Persians, Iranians and Hindus; for all the branches of the race use the same type.

The oldest example is usually considered to be the plow found on the moor of Doestrup in Jütland, although the plow from the cliff near Bohuslän in Sweden may be older. The Doestrup plow is in that case neolithic. The so-called Hesiod plow from Greece is much more recent—about the ninth or tenth century B. C.

This type, which developed from the spade, consists in its oldest form of three parts, and in this form exists even to the present day in various localities. The well-known "hook" of Mecklenburg and the instrument known at Cologne as a "wessel" or Huns plow,[3] still in use today, are undoubtedly derived, in part, from the primitive spade-plow, and can show a neolithic ancestor in the plow found at Dabergotz, near Berlin. This indeed shows the typical

[2] See Cook, O. F. Wild Wheat in Palestine, U. S. Department of Agriculture, Bureau of Plant Industry, Bull. No. 274, Washington, 1913.

[3] So called because it was supposed to have been introduced by the Huns.

VARIATION OF WILD WHEAT

This large seeded "sport" of the Palestinian wild wheat appeared in cultivation at Bard, California. It is here shown natural size. The head at the right shows in a striking way the fragile nature of the articulations in this wild wheat—a character that is also found in wild oats and other grains. In the struggle for existence in nature, such fragile articulations are an advantage to the plant, for they enable its seeds to be more readily disseminated; under cultivation, however, they are a distinct disadvantage to man, making the grain much harder to gather. One of the most striking results of the domestication of wheat, therefore, has been a reduction in this character, until the present varieties are reached, in which the head remains compact until it is threshed. (Fig. 2.)

transition form from primitive to higher construction—a combination of the spade-plow and the wedge-plow.

Another form going back in principle to the spade-plow is the so-called "zoche," the ditch-fork or mattock-plow. It is used principally in Slav districts—Prussia, Littauen, Letten—but was used much farther west at an earlier date, for the Lüneberg farmers of Wendland yet say "zochen" for "pflugen," to plow.

All of these plows have a beam which does not permit the depth of the furrow to be regulated; they must be dragged by the plowman, which involves very hard labor. At a very early age man endeavored to evolve a form that would lighten his labor, and produced:

2. The wedge or sole-plow. This allowed the depth of the furrow to be regulated, and lightened the labor. The principle is to change the position of the shoe instead of the handle, as was required in the ealier form.

By the addition of a mold-board this plow developed into a garden plow, with which in prehistoric times Germans or Celts cultivated the so-called High Fields (Upper Bavaria, Jütland). Its development can be followed in every country among all the Indo-Germanic peoples, and the type is today in use everywhere.

THE PLOW IN GREECE.

From Greece we possess a picture of the goddess Kora (Persephone), with an ancient model of this type of plow. It was formerly considered that the distribution of this plow was from Greece, with the spread of Hellenic culture. Such is not the case, for we find this type of plow among all Indo-Germanic peoples, even in places where Grecian influence can not even be suspected to have reached. In its most primitive form, it has been found fossilized in West Prussia, near Papau.

At a very early period a wheel-frame was constructed, mold-boards added, and small improvements made, with which the plow became one of the household utensils of the Indo-Germans and accompanied them on their wanderings. We find this type among the Iranians and Hindus, in the Caucasus among th Georgians and Ossetes, still in its most primitive form. The Slavs have changed it only in small details, not to advantage, and of its original Indo-German origin there can be no doubt.

As a result of his deep researches, Braungart[4] comes to the conclusion that the original home of primitive Indo-German agriculture in the broadest sense of the word, is to be sought in the present-day German empire and surrounding territory, and only to an unimportant extent in southern Scandinavia. Further, that the agricultural implements were, in principle at least, well developed as early as the late Stone Age, and that the separation of the peoples at the beginning of their migrations is to be placed at the middle, if not in the earlier part, of this neolithic age. The old Indo-Germans therefore possessed, at least 10,000 years ago, a well-developed art of agriculture, were a settled population, and had a considerable civilization.

Finally, a few words on my special subject, animal husbandry.

The most important domestic animals—dogs, pigs, cattle, sheep, goats—confront us, sometimes represented by numerous types, in the new Stone Age. The horse seems not to have been tamed until later; likewise poultry.

THE DOG PREHISTORIC.

The dog, it is generally admitted, comes into our field of knowledge at the same time as man himself. And before proceeding I want to remark that we agriculturists must take with caution the very suggestive but very fanciful picture of Ed. Hahn, of early man domesticating animals from religious motives. Hahn believes that man subdued and bred wild animals in order that he might always have at hand subjects for offering to the gods. Whoever

[4] Braungart, R. Die Urheimat der Landwirthschaft aller indogermanischen Völker an der Geschichte der Kulturpflanzen und Ackerbaugeräte in Mittel-und Nordeuropa nachgewiesen. Heidelberg, 1912, C. Winter.

PREHISTORIC AGRICULTURE

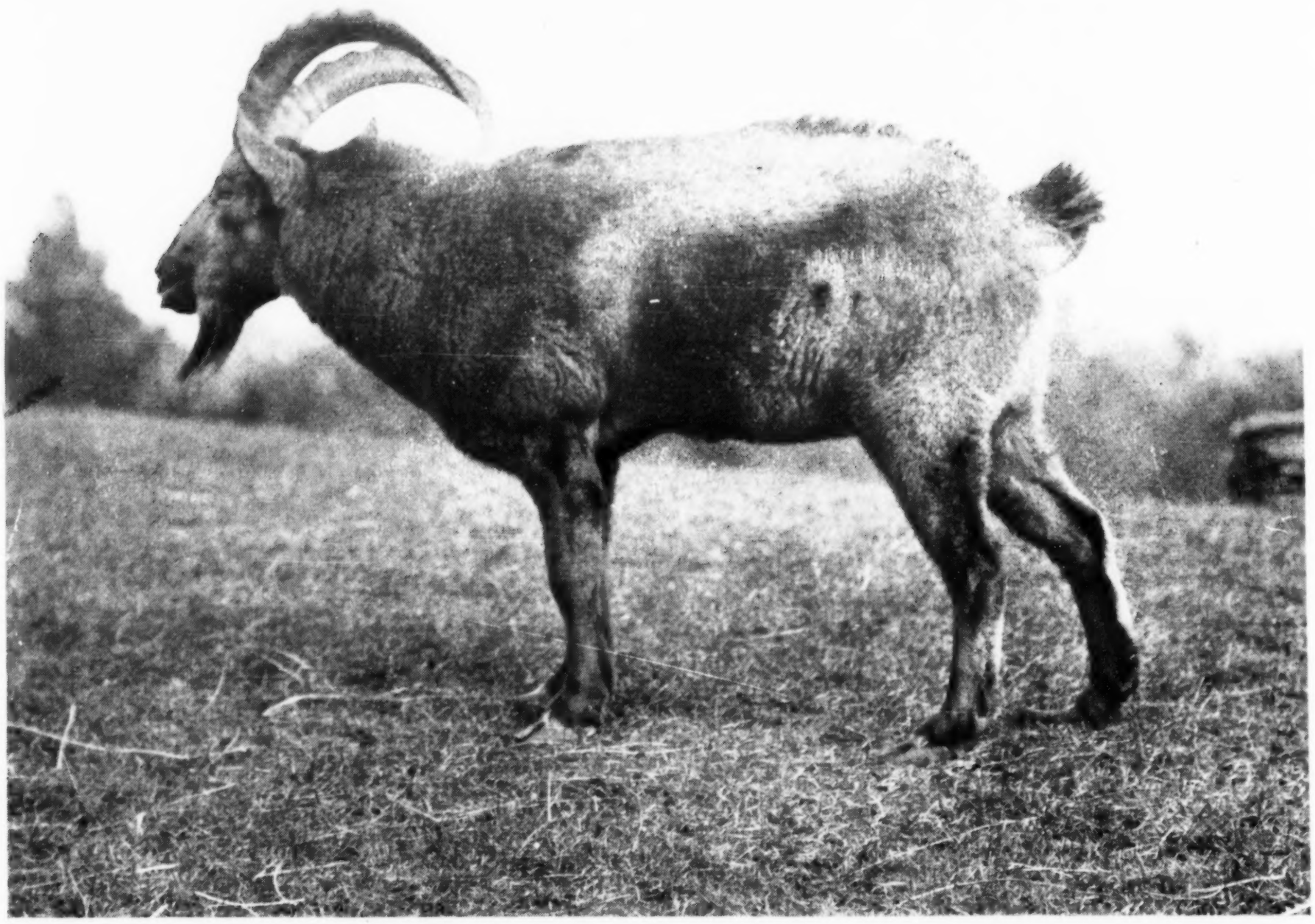
Resident of the Bronze Age plowing with a yoke of oxen. This engraving was made with flint on the carefully smoothed wall of a cave near Bohuslän in southern Sweden. It dates back probably several thousand years B.C., and possibly much earlier, according to Braungart, from whom the cut is taken. The simplest possible form of plow not operated by man alone is here shown; it is still found, almost unchanged, among modern Iranians in northern India. (Fig. 3.)

knows the sober mind of the Germanic peoples must reject this hypothesis absolutely and agree that utilitarian motives alone acted. Instead of following wild animals with the hounds all his life, man found it more convenient to pen up the wild animals and feed them. Further progress in breeding came by its own momentum.

Among dogs we find today a host of varieties and types. That is partly due to the diversity of the wild material—wolves and jackals—which originated them, in part to the extraordinary variability of the species. Apparently the dog is a product of the old Stone Age.

Cattle were probably—in part, certainly—domesticated in the first part of the new Stone Age. The wild stock was the Ur or Aurochs in various forms. I have made a particular study of the ancestry of cattle and especially of the black and white race.[5] The literature designates it as *Bos taurus germanicus*, as distinguished from the red breed, *B. taurus celticus*. The first is considered to be a product of Germanic breeders, the latter of Celts. But when one collects all the data regarding the earliest known distribution of these types, and compares it with the known history of the peoples, one arrives at quite an opposite conclusion. For the black and white cattle are beyond all doubt a heritage from the Celts, who in those days lived to the east of the Germanic peoples, in the present empire of Russia, while the Germans had red cattle with light muzzles and sometimes white spots. These two varieties of cattle were distinct in origin and have no connection with each other. From the fact, however, that these two neighboring peoples had different kinds of cattle, we must conclude that the domesticating of cattle went on independently in a number of separated districts, at a date subsequent to the separation of Celts from Germans and after the art of agriculture was tolerably well known. It was not until much later that the Celtic tribes, wandering westward, took their black and white cattle with them, and from the distribution of these cattle during historic

[5] Represented in the United States principally by Holstein-Friesian cattle.



ANCESTOR OF DOMESTIC GOATS

The Pasang or so-called Grecian Ibex (*Capra hirtus*, var. *aegagrus*). Although Dr. Dettweiler seems not wholly to accept the theory, most zoologists are firmly convinced that the Pasang is the ancestor of the domesticated goat of the present day (*Capra hirtus typica*). In the time of Homer it was common in Greece, but now is confined principally to Asia Minor, Persia, and Afghanistan. R. Lydekker says the Swiss domesticated goat is "certainly its descendant" and that it probably is the foundation of all other modern breeds, although local crossings with other wild species may have aided in producing the diverse modern races. It is a slender animal, three feet high at the shoulder, and ranges far up in the mountains, usually avoiding the lowlands altogether. Photograph by E. R. Sanborn, New York Zoological Society. (Fig. 4.)

times we have some ground for drawing conclusions as to where the Celts settled on various occasions. We can follow them through Germany and Jütland, southern Sweden and Norway, into France, Great Britain, Spain and finally Asia Minor.

SWINE EARLY TAMED.

Swine seem to be an older acquisition of the race, since Celts and Germans possessed the same breed, a huge hog with pendulous ears. No wild form of this type is now in existence—it has died out along with the wild ox, the ur, or aurochs, which furnished the material that made up domestic cattle. The short-eared swine of eastern Germany did not arrive until the invasion of the Slavs.

We can distinguish various breed of sheep, without being in a position today to say whence they came. The Neolithic people had serveral types.

As for goats, researches still in progress show that we have two very different forms, neither of which is of known ancestry. Augst has proved that there is a German goat, with curved horns, and a Celtic form with larger,

sweeping horns. The latter type long ago began to preponderate and seems likely in a short time to dispossess the Germanic type altogether.

With horses we are also in a position at present to distinguish several original stocks. The Celts deserve credit for taming the oriental horse, the so-called warm-blooded one; and perhaps this fact gives us a clue to place the Scythians and other nomads of the Russian steppes in their proper place, ethnologically. We may assume that the Celts took this horse with them on their wanderings, on the one hand eastward—Iranians, Persians, Medes, Cimmerians, etc.—and on the other hand westward. The oriental type of horse was well-known for the late neolithic period, and the Bronze Age, through excavations in many parts of Germany and France, even to England, and furnished support to the hypothesis of immigration from Asia. Today we know that it is a genuine old Indo-Germanic product, which never had anything to do with Asia, still less with the Arabs. For the latter got it only in a relatively very recent period, probably about the beginning of the Christian era. Herodotus states expressly that the Arabs in the army of Xerxes had only camels, that they were the only people without horses, and Strabo notes the lack of horses in Arabia. Probably the horse was introduced to Arabia from Egypt. The Egyptians, however, are supposed to have received it (1800 B.C.?) from Libya to the westward; and here we enter upon hotly contested ground.

THE NORTH AFRICAN BLONDES.

In North Africa one frequently finds remains of the blonde, northern European race, which obviously was there far prior to the invasion of the Vandals; there is much reason to believe that in a remote time Northern Europeans must have entered Africa through Spain. The dolmens and other finds add evidence. When one collects all the scattered data regarding the horse, it seems not at all impossible—however fantastic such an idea may at first sight appear—that in the prehistoric time, perhaps about the time when the Hellenes and Italians were wandering, Celts entered Spain and crossed over into Africa, where their posterity, the Berbers, still work for the French and Italians. Through these, then, the horse would have been carried along the Mediterranean to Egypt and Arabia, whence it was brought back centuries later, to be paired in England with its much changed relative, the Celtic Pony, and produce the modern running horse, the so-called thoroughbred.

The Germans themselves had a heavy, clumsy horse that was more useful for draft than for riding purposes. From this, during centuries of breeding, selection, and improved environment, the great cold-blooded breeds, the cart-horses, were produced. They are a product of the forests, whereas the thoroughbred is a product of the steppes.

If one asks why our forefathers at a much earlier day had not tamed horses, along with cattle, one must remember that even a few thousand years ago the horse was much smaller than he is today, similar to our ponies. It was too light to ride, and in the yoke the oxen surpassed it. There was, therefore, no great advantage to be gained in domesticating it, since its flesh hardly justified breeding operations, the meat of swine, sheep and goats being obtainable more cheaply and conveniently.

As a people, the Celts have become insignificant, but their horses, their cattle and more recently their goats have gained an important, even dominating, part in the animal industry of Europe.

Permanent Reform

Until the movement of heredity is changed, physical and moral deterioration will move side by side in ever-expanding streams. In the long run no reform can pervail which does not look toward the creation of a sober, clean and law-abiding stock.—Rev. Amory H. Bradford: Heredity and Christian Problems (1895).

COAT COLOR IN HORSES

Tabulation of Color of 42,165 Horses Allows Definite Conclusions to Be Drawn as to Value of Different Factors—Errors in Registry and in Genetic Description of Colors—Connection Between Gray and Roan.[1]

W. S. ANDERSON

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HURST, Wilson, Harper, Sturtevant, Anderson and others have published papers on the Inheritance of Coat Colors in Horses. It is the purpose of the writer to give a summary of all the available figures on the subject and his interpretation of them. The sources of the figures collected are the various Stud Books. As a matter of fact these can not be accurate. I, myself, have used the American Saddle Horse Register. This Register has been compiled within two or three decades and has been revised within a decade. I find errors in it approximating two percent. for color and as great a percent. of errors that might be considered of a typographical nature. There is no reason to believe that other registers are more nearly accurate than the Saddle Horse Register.

As will be noticed from the following table of figures the matings have been grouped under the registered colors as: chestnut x chestnut, chestnut x black, chestnut x brown, etc. That is, when both sire and dam are chestnut it is designated a chestnut x chestnut mating. When one is chestnut and the other is black it is tabulated as chestnut x black and so on. No attempt has been made to keep the records for sexes, for the reason that color is transmitted regardless of sex. The result from mating a bay stallion to a chestnut mare is the same in the color of the foal as if the cross had been reciprocal, a chestnut stallion mated to a bay mare.

The stud books recognize the following colors in horses: gray, roan, dun, bay, brown, black and chestnut. As a rule the variations of each of these colors are not recorded in the stud books.

The gray coat is made up of white and black hairs and varies from the almost white to the almost black, and includes a large class of horses whose coat is of the dappled pattern. When young, the gray horse exhibits this dappled condition or is what is designated iron gray, but as age comes on the dapples disappear and white and black hairs are to be found. Later on the black may almost be lost and result in a white horse. This white, however, does not seem to be of the same nature as the white found on spotted ponies and some classes of horses. This latter is a snow white with white skin underneath, while the white found on the old horse is due to the partial disappearance of the black hairs.

The roan pattern assumes three forms. One of these is the red-roan in which the coat is composed of bay and white hairs. The second is the blue-roan which constitutes a coat of black and white hairs. The other form of the roan pattern is the chestnut roan. The coat in this case is due to white and chestnut hairs.

DUN COLOR RARE.

The dun or cream colored coat is not found in any great numbers. It varies in shade from the dark to the light cream. Once in a while the mane and tail have the same cream color as the body coat, but the most usual condition is dun body and black mane and tail with black on feet and legs.

[1] The material here presented has been published in Bulletin No. 180 of the station, July, 1914.

BREEDING OUT THE GRAY

This gray mare is out of a gray dam, but has solid colors in her sire's ancestry. Her foal is bay by a bay stallion. Gray is ordinarily dominant to bay (and to other colors) and the fact that it does not appear in this colt shows that he has lost it permanently and that he can not transmit it to his own progeny. (Fig. 5.)

The fashionable color for almost all classes of horses is the bay.[2] The average bay horse has bay hairs on the body, but black on the legs, mane and tail. This black may extend along the back and up the legs to the body and even appear on the underline of the barrel. When the sides of the body show black in alternating patches with bay, the horse is frequently registered as a brown. This brown is known among horsemen as a mahogany brown. As common practice allows mahogany browns to be registered brown it makes it quite difficult to interpret some results as shown by matings. The mahogany brown is a bay. The coat is a compromise between bay and black but it is not blending although it resembles a blend. In technical terms it is a simplex bay, that is, a bay produced by two germ cells one of which carries the *determiner* for bay, the other carrying the *determiner* for black, the bay *factor* in this union not showing the usual dominant strength which should exclude black hairs from the body. The mahogany bay represents the one extreme of bay and varies from this condition to the bay that has no black hairs on body or legs. The bay hair varies in shade from the very dark wine colored bay to the very light shade close to chestnut.

In all the stud books examined the horses registered as brown may vary in shade from the dark or mahogany bay to black. As noted above the so-called mahogany brown is a dark bay and should be so registered, although custom sanctions the other method. The horse which is called seal brown by horsemen is almost a black horse. The top line is all black, as is the mane and tail. The legs, except for possible white markings, are black up to the body. The body is very dark, in some cases showing a lighter shade near the flanks and back of the nostrils. The flanks and muzzle are said to be tan in color.

The lighter shade, called tan, on muzzle, flanks and sometimes the hips is not due to the presence of brown hairs for the reason that there are no

[2] Comparison of early and late volumes of the Register shows that the American Saddle Horse is going rapidly to a chestnut color. This is partly due, doubtless, to the ease with which chestnuts can be bred, all that is necessary being to mate a chestnut sire and chestnut dam.

true brown horse hairs unless some shades of bay or chestnut be so called. The tan shade is due to an alternation of black and bay hairs, the bay hairs being very dark and in many cases only showing bay on the outward ends. The horse designated as seal brown is a black in which not all the bay has disappeared. There is just enough of the bay tendency left to produce lighter shades in places on the body.

Black varies in shade from the so-called seal brown to the jet black. Most black horses when exposed to the sun for some weeks show a faded condition. The ends of the hair show a bay tinge.

The chestnut coats present a variety of shades from the dark liver color to the light sorrel. The mane and tail follow closely the body shades in variety, the lighter chestnuts often showing the crushed strawberry or flaxen shade in the hair of the mane and tail. There is the presence of enough of white hairs among the chestnut ones to give it the light effect.

MANY MATINGS STUDIED.

In going through the American Saddle Horse Register I secured the color in 5,591 matings, which involve the color of 16,773 horses. To these numbers I am able to add from Sturtevant's tables 8,464 matings, giving a total of 14,055 matings or the color of 42,165 horses. This number is sufficiently large, it seems to me, to enable proper deductions to be drawn, unless it is in the case of the rare colors.

The tables herein given make no distinction in the shades enumerated for the reason that the registration books do not give them. The percentages are figured in round numbers so as to exclude all fractions.

The tabulated matings and the resultant foals are:

CHESTNUT X CHESTNUT.

Breed	*Chestnut*	*Black*	*Brown*	*Bay*	*Authority*
Thoroughbred	1095	9	(bay or brown)		Hurst
Shire	44	1	1	5	Wilson
Trotter	69	0	0	0	Sturtevant
Saddle	410	0	0	0	Anderson
Total	1618	16 not chestnut			
	99%	1%			

CHESTNUT X CHESTNUT.

Suffolk	12497	0	0	0	Anderson

CHESTNUT X BLACK.

Saddle	111	83	20	124	Anderson
	33%	24%	6%	37%	

CHESTNUT X BROWN.

Saddle	60	32	31	130	Anderson
	24%	12%	12%	52%	

CHESTNUT X BAY

Saddle	597	56	49	764	Anderson
	41%	4%	3%	52%	

BLACK X BLACK.

Percheron	0	49	2	not black	Harper
Shire	2	39	0	3	Wilson
Clydesdale	0	36	2	0	Wilson
Trotter	2	34	4	2	Sturtevant
Saddle	7	137	7	0	Anderson
Total	11	295	15	5	
	3%	90%	5%	2%	

BLACK X BROWN.

Breed	*Chestnut*	*Black*	*Brown*	*Bay*	*Authority*
Thoroughbred	0	8	20	12	Wilson
Shire	4	39	36	19	Wilson
Clydesdale	1	61	106	34	Wilson
Trotter	1	11	9	5	Sturtevant
Saddle	8	79	48	45	Anderson
Total	14	198	219	115	
	3%	36%	40%	21%	

BLACK X BAY.					
Thoroughbred	14	1	27	33	Wilson
Shire	19	39	43	125	Wilson
Clydesdale	7	40	67	104	Wilson
Trotter	7	16	31	48	Sturtevant
Saddle	76	199	93	324	Anderson
Total	123	295	261	634	
	10%	22%	20%	48%	
BROWN X BROWN					
Thoroughbred	11	6	114	78	Wilson
Shire	2	7	27	20	Wilson
Clydesdale	0	32	165	34	Wilson
Trotter	0	5	7	7	Sturtevant
Saddle	0	14	21	18	Anderson
Total	13	64	334	157	
	2%	11%	59%	28%	
BAY X BROWN.					
Thoroughbred	123	10	365	741	Wilson
Shire	5	23	56	133	Wilson
Clydesdale	5	25	254	206	Wilson
Trotter	8	9	31	81	Sturtevant
Saddle	36	65	111	285	Anderson
Total	177	132	817	1449	
	7%	5%	32%	56%	
BAY X BAY.					
Thoroughbred	270	1	125	1295	Wilson
Shire	28	13	18	287	Wilson
Clydesdale	5	6	59	243	Wilson
Trotter	9	1	3	46	Sturtevant
Saddle	162	86	95	960	Anderson
Total	474	107	300	2831	
	13%	3%	8%	76%	

ROAN X CHESTNUT.

Chestnut	*Black*	*Brown*	*Bay*	*Gray*	*Roan*
9	3	2	9	1	14

ROAN X BLACK

1	11	3	1	0	15

ROAN X BROWN.

1	5	16	18	1	28

ROAN X BAY.

9	5	13	39	1	50

ROAN X GRAY

0	0	3	0	5	7

ROAN X ROAN.

0	0	0	3	2	9

ROAN X ROAN.

0	0	0	3	2	9

GRAY X NOT-GRAY

	Gray	*Not-Gray*	
Thoroughbred	73	56	Wilson
Shire	146	186	Wilson
Clydesdale	9	15	Wilson
Trotter	141	142	Sturtevant
Saddle	70	129	Anderson
Total	439	528	
	46%	54%	
GRAY X GRAY.			
All Breeds	47	18	
	72%	28%	

The writer found while tabulating the matings for color in the Saddle Horse Register that some foals were reported not chestnut from chestnut matings. I was able to find the owners or breeders of these foals. In every case I found that a mistake had been made in the record. I was able to report 410 chestnut x chestnut matings which all resulted in chestnut foals. Later I secured Hurst's figures, 1905 chestnut x chestnut matings with a reported nine not chestnut. Hurst used the Thoroughbred Register of England and must have gone back in the earliest numbers. There is no doubt in my mind, as Hurst himself intimates, that the nine are mistakes in registration. In all breeds there are 1618 chestnut x chestnut matings producing all chestnut except 16 according to the records.

SUFFOLKS ALL CHESTNUT.

Recently, I have secured from Fred Smith, Secretary of the England Suffolk Horse Society, a statement to the effect that this Society has registered 12497 horses, all chestnuts from chestnut matings. The breed traces back to a chestnut horse as the founder in 1769. One of the requirements is that a Suffolk shall be chestnut.

I have been contending for three years that chestnut is a true recessive. I have asked in the stock papers for an example of a foal that is black, bay or gray from parents both of which are chestnut. No breeder has volunteered the information because he has not had that experience in his stud. The twelve thousand matings and over from the Suffolk Horse Society substantiate my position.

Other evidence of its recessive nature is necessary than that chestnut matings produce only chestnut foals. Any color can behave that way in reproducing itself if it be pure bred. The matings of the Suffolk Horse all come from chestnut ancestry and alone would not be conclusive proof that chestnut is a recessive. The chestnut matings which I have tabulated present individuals with all colors in their ancestry. There would be a tendancy to transmit these various colors if it be not recessive.

Another conclusive proof of its recessive nature is its production from other colors. The above tables show that in black x black matings there are 3% chestnut foals, black x brown give 3% chestnut foals, black x bay give 10% chestnut foals, brown x brown give 2% chestnut foals, brown x bay give 7% chestnut foals, bay x bay give 13% chestnut foals. Here are six classes of matings with no external evidence of chestnut in the animals mated, yet regularly there come from them chestnut foals. If chestnut is recessive this is what we should expect and we should expect the chestnuts to breed true to their color when thus produced. The chestnut horses do breed true for chestnut no matter what the color of their ancestry has been.

A striking example of the recessive nature of chestnut is to be found in The Theorist, a trotting bred stallion. The three generations before him are of solid colors other than chestnut. The fourth generation has one chestnut individual, and the fifth two. He is chestnut with flaxen mane and tail.

SOME CHESTNUT MATINGS.

The other writers on the subject have not given any figures showing the behavior of chestnut when mated to bay, brown and black. I find that black x chestnut matings give 33% chestnut, 24% black, 6% brown, and 37% bay. Brown x chestnut matings give 24% chestnut, 12% black, 12% brown, and 52% bay. Bay x chestnut matings give 41% chestnut, 4% black, 3% brown and 52% bay. The brown x chestnut matings give 52% bay. This is not unexpected when we remember that most of the horses registered brown are genetically bays and should have been so registered.

A real difficulty is encountered with the black x chestnut matings, for here we find 6% brown and 37% bay. Both black and chestnut are recessive to bay and there should be no bay foals from this class of matings. There is evidently some relationship between the factors which produce chestnut and black and the factors which produce bay. Just what this relationship is I am unable to say.

There are some stallions that are homozygous for their own colors and are unable to produce even from chestnut mares any chestnut foals. The two bay trotting stallions, Bingen and Alcyo, we have found, do not produce any chestnuts, although each one has had numerous mares who to other stallions do produce chestnut foals.

Black is dominant to chestnut and hypostatic to brown, bay, gray and roan. The percentages are from a total of 326 black x black matings: 90% black, 3% chestnut, 5% brown, 2% bay. The brown and bay from black matings are very small, not enough to vitiate the conclusion that black is hypostatic to these two colors as well as to gray and roan. Under the present methods of registration there can be no sharp line of demarcation between bay, black and brown. I am confident that as the records are now made up enough errors have crept in, by registering bay or brown, to account for the exceptions above mentioned. In the opinion of the writer, from true black horses mated to true black, only black and chestnut foals will be obtained. The percentage of black colts from the cross of black and brown and black and bay are 36% and 22% respectively; just about the figures that the Mendelian law would require.

In the tabulation given above the stud book records are taken for brown. As indicated elsewhere in this bulletin mahogany bays are usually registered as brown. All mahogany bays are genetically bay and should be registered as bay.

The seal brown which characterizes the larger number of horses registered as brown is just a light shade of black horse and should be so registered. To make all stud books conform to a uniform standard the so-called brown should be eliminated. The mahogany browns should all be classed with bays. The seal browns should be classed with blacks. Should this be done the black horse would have its variations in shade as do the other recognized colors.

In view of all the evidence the series seems to be: chestnut recessive to all, black dominant to chestnut and recessive to all others, bay dominant to chestnut and black and recessive to the three coordinate colors, gray, roan and dun.

The colors can be arranged in three series:

Gray	Roan	Dun
Bay	Bay	Bay
Black	Black	Black
Chestnut	Chestnut	Chestnut

The color at the top of the series is dominant to all members of the series. Chestnut comes last and is recessive to all above. There is no question that bay is recessive to gray, roan and dun, and dominant to chestnut and black.

WHEN BAY IS DOMINANT.

Our records show 3712 bay matings, and there is not a single gray, roan, or dun horse thus produced. This is convincing evidence that bay is hypostatic to the three colors which head the various series.

The evidence of the dominant nature of bay to black and chestnut is that out of the 3712 bay matings 76% are bay, 3% black, 13% chestnut and 8% the so-called brown.

That gray and roan are dominant to bay there can be no doubt. Nine hundred and sixty-seven foals from matings gray x not-gray produced 46% gray and 54% not-gray. It is known that homozygous gray when mated with any of the four popular colors will always produce a gray. It is only from a heterozygous gray that other than a gray can be produced. We have no records that would indicate the comparative strength of dun, roan and gray. For the present we place them at the top of the series as of coordinate strength.

The factor for the roan pattern seems to be independent of the factor for color. There are the three factors, or three causes, for the colors, chestnut, black and bay. Intimately mingle white hairs with chestnut and the result is a chestnut roan. White hairs with the black coat in sufficient numbers give the blue or black roan. The bay, or strawberry, roan is due to a mingling of white with the bay coat-color. The factor, or cause, for the roan condition

appears to work independent of the determiners for the colors.

There is a reason in the behavior of color factors, in transmission, why a coming foal shall be a bay. Acting in the same germ cells for this foal is the factor for the roan condition and the combined result of the two factors is to produce a bay roan. Should the factors for color have been black or chestnut instead of bay the roan factor would have acted in the same manner except the result on the foal would have been a black roan or a chestnut roan, according to the resultant of the factors for those colors.

The determiner for roan is present or not present in the germ plasm. If present it will be seen in the coat of the mature horse. Its presence is dominant over its absence. It in no way interferes with the inheritance of the colors among themselves.

Like the gray, roan cannot always be detected in young foals. They appear to be bay or black at first, and some show this condition until they shed, when the roan becomes visible.

When once in the germ plasm of a strain of horses its persistence is remarkable. The famous trotting sire Jay Bird got his roan from his grandmother, Lady Franklin, about whose ancestry we know nothing. A large percent. of the get of Jay Bird were roan and it lingers in his descendants to some extent even to the present. But when it disappears it is like the gray, it will not reappear. To get it again it is necessary to go back to it.

A good illustration came to our attention recently. An intelligent horse breeder bred the progeny of a famous gray horse for five or six generations. He lost the gray at the beginning, but did his breeding expecting it to reappear with each new generation. He of course met with disappointment.[3]

So alike is the behavior of gray and roan that the evidence points to a unity of the two. The gray horse is, perhaps, one form of the black roan. When the pattern is in the dappled form which with the black disappears with age, we call it gray. The difference between the gray and black roan is only one of pattern and the quantity of white hairs. The white is much more plentiful in the gray than in the roan. It is a question of quantity, I believe, and not of kind which distinguishes the roan from the gray. I am confident that further research will show a close relationship of the factors for gray and roan.

There is evidence that dun is dominant to the solid colors, but there is no evidence of the comparative strength of gray, roan and dun.

[3] By eliminating at each generation the few chestnuts produced, a breeder can easily secure a family of horses that will produce nothing but blacks. To produce a family of bays requires more time and patience, since the external appearance of a bay tells us little of his genetic qualities. Grays are becoming scarce and of very mixed ancestry—to produce a family of horses that bred pure gray would now be a difficult task for any except the Percheron breeder.

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ALBINISM IN MAN

Extensive Researches of Galton Laboratory Lead to Denial of Its Mendelian Behavior—Warning as to Enunciation of Rules Governing Marriage—Eugenists Must Seek More Knowledge Before Offering Advice.

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HAPPILY contrary to expectation, the six volumes [1] already issued from the mathematical atmosphere of the Galton Laboratory (London) on the subject of albinism present no such arid acreage of numbers as one is usually invited to contemplate by investigators at that institution. With Adam and Eve (who have been assumed *a priori* by Christian mankind to have been white) as a starting point, the authors have traced the history and geographical distribution of albinism with all the charm and freshness of a traveller's tale, while a passion for micrometric accuracy and critical sifting of authorities have rendered the reading of the whole first volume a scientific delight. The second volume of text is devoted to the treatment of isolated cross sections of the problem of albinism, such as the microscopic structure of the albinotic eye in man and animals, the structure and composition of albinotic hair, seasonal variations in granular pigment content in the coats of birds and animals, and the many side-lines that such a study naturally involves. Two photographic atlases and one volume containing over 650 pedigrees of human albinism and partial albinism attest the remarkable co-operation that it has been the well-deserved good fortune of the investigators to secure. Detailed descriptions of the pedigree material, whose collection and working up has covered already a period of eight years, fill the text of Part IV, save for the space given to a bibliography of 700 titles of works on albinism, the cream of which has been incorporated in the present monograph.

A bare list of the interesting facts concerning albinism in history, geography, medicine, folk-lore and anthropology would more than fill the space allotted for this brief review, so that only a few of the high-lights can here receive mention.

VARIETIES OF ALBINISM.

A complete albino, for the purposes of this investigation, is described as an individual whose skin is of a characteristic pallor or milky whiteness, whose hair is white tinged possibly with yellow or straw, and whose eyes have pink or red pupils, translucent irides with the usual accompaniments of defective vision, nystagmus and ametropia. Incomplete albinism embraces all conditions where the aforementioned factors are not all present. Albinism as thus defined occurs practically in every section of the world and in almost every variety of the human race, manifesting itself in the black races of Africa, the brown races of the Americas, the yellow races of Asia and the whites of Europe and America, both in its complete and incomplete form. The range of variation, from a dash of whiteness on the skin or the dilution of pigmentation in an eye to complete albinism, is held by the authors to preclude the possibility of treating this condition as a unit character in heredity and to indicate that before it can, even with the greatest latitude, be so treated, a vast

[1] Drapers' Company Research Memoirs, Biometric Series. A Monograph on Albinism in Man, by Karl Pearson, E. Nettleship and C. H. Usher. Vols. I–VI. London, Dulau and Co., Ltd.

amount of further work must be done along the lines already worked in part.

Pigmentation in albinos, especially that of the eye, seems to increase with age. Nystagmus is almost always present in albinos and a high degree of hypermetropia and astigmatism are found in higher correlation with albinism than with normality, but the poor sight characersitic of individuals affected with albinism is due more to deficiency of retinal pigment than to these defects. Hair color is due to pigment diffused through the fibrilae of the hair like a dye, or as distinct granules of pigment bewteen the fibrilae. This duality, because the authors consider the absence of granular pigment the distinguishing mark of albinism in hair, is presumed to preclude the study of the heredity of pigmentation without the aid of the microscope. Further, there is the suggestion of changes in pigmentation, such as those that accompany age and those that seasonal changes occasion, which the authors think must be taken into account for thoroughness' sake. Experiments on Pekinese spaniels, conducted by the investigators, led to the drawing of conclusions similar to those derived from the study of albinism in man with special emphasis on the fact that, although tested according to Mendelian formulas, "no simple form of Mendelian theory applies to the coat color of dogs."

Although the spirit of fairmindedness runs through the whole monograph, yet one cannot help noticing a distinct refrain of antimendelism which crops out again and again with such emphasis that it must be mentioned here not through any desire to enter this field of controversy but because it nucleates so much of the material dealt with and seems to play so large a rôle in the thought of the authors that it may not well be omitted. As this memoir comes from a laboratory of Eugenics, one is led to conclude that its principal object is related to this young science and that whatever social connotations it may carry are more important than its bearing on or relation to ophthalmology or geography. The following quotation, therefore, would seem to embody the essential spirit of the whole and may fittingly be cited as indicative of the main conclusions of the work already done.

Say the authors:

"As we have seen in the course of this work albinism is a graded character, and we have every reason to believe that both in man and dogs separate grades are hereditary. Further than this we should hesitate to go at the present stage of our experimental work.

MENDELISM AND EUGENICS.

"Mendelism is at present the mode —no other conception of heredity can even obtain a hearing. Yet one of the present writers at least believes that a reaction must shortly set in, and that the views of Galton will again come by their own. At any rate as far as we have gone at present the experiments on dogs seem to indicate that there is still a chance for philosophic Darwinism—*i. e.*, the theory that small variations are continuously occurring and can be perpetuated by selection. The problem of whether philosophical Darwinism is to disappear before a theory which provides nothing but a shuffling of old unit characters varied by the appearance of an unexplained fit of mutation is not the only point at issue in breeding experiments. There is a still graver matter that we face, when we adduce evidence that all characters do not follow Mendelian rules. Mendelism is being applied wholly prematurely to anthropological and social problems in order to deduce rules as to disease and pathological states which have serious social bearing. A careful record of facts will last for ages, but theory is ever in the making or the unmaking. In all that relates to the evolution of man and to the problems of race-betterment, it is better to admit our present limitations than to force our data into Mendelian theory and on the basis of such rules propound sweeping racial theories and inculcate defiite rules for social conduct. Even if the offspring of an albino parent be themselves normal, we cannot advise them that all is safe if they marry into normal stock; for not only is Mendelism

not yet demonstrated for human albinism, but who shall determine what is 'normal' stock, when over and over again the albino appears in the mating of two stocks which have no record of previous albinism? Let us rather adopt the tone of the sooth-sayer in Antony and Cleopatra and when we are asked 'Is't you, Sir, that know things?' reply modestly, 'In Nature's infinite book of secrecy a *lit!le* can we read.' We await the gradual building up of more complete knowledge."

In perusing this truly admirable piece of hard and conscientious work, despite the manifest desire of the authors to square the facts gathered with the underlying principles that may be found to govern the appearance of the facts, there comes irresistibly to mind Mrs. John Martin's likening of scientists to sick widow's children who keep gathering nuts which nobody at home can crack and pointing to the nuts as wealth. The authors of this monograph have gathered an invaluable store of interesting facts and their desire is to relate these facts to the problem of heredity, but whether we must wait until the microscope has told us all it knows of human hair, and eye, and skin before we may conclude, from the symboled pedigrees that are coming to hand in greater and greater numbers, that albinism behaves recessively or no, is an open question. With the greatest respect for the scientific labors of our three authors and their generous collaborators in the field of detail and correlation, it would still appear that, in so far as the strictly hereditary and social aspects of albinism are concerned, this monumental work is indeed, as the authors have been the first to see it, but a small beginning and initial stimulus for further research.

Heredity and Environment

The correctness of statistical measurements of the relative force of heredity and environment is vigorously defended by Karl Pearson in Biometrika (X, 1, April, 1914), in answer to recent writers in the *Eugenics Review* who have declared such measures to be fallacious. Pearson replies that his critics question the accuracy of the statistical method because they do not really understand what a coefficient of correlation is, nor what mutiple correlation means. His own well-known position is that heredity is at least five or ten times as important as environment, in the individual; he proceeds to show that this is really a conservative estimate, and that even in the most extreme case supposable, the influence of heredity would still be preponderant. He assumes that there is an *infinity* of environmental factors which have the same correlation as a parent with the child, and that there is assortative mating of the child's parents; even in such a case it is only necessary to take the grandparents into account to show that "together grandparents and parents would influence a man's character more than an infinity of environmental factors of the same grade of correlation, because the latter factors are far more highly correlated together than several of our relatives."

Eugenic Progress

A period seems to come in the religious development of nearly every civilized community when the moral conscience is awakened to its responsibility for the weaker and less competent stocks, who, inheritors of the racial faults and failings, are true scapegoats by which the progress of the race is assured to others. If, however, the effect of this altruistic movement in directing the attention of society to the condition of the unsuccessful and unhealthy be to discourage and hamper the families of the able and robust, no further racial progress is possible, and degeneration will set in.—W. C. D. and C. D. Whetham: Heredity and Society.

THE LAWS OF NAUDIN-MENDEL

An Interpretation of the Statistics of Pearson, Nettleship and Usher, on Albinism in Man—Practical Rules to Regulate Marriage of Members of Tainted Family Stocks.[1]

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I BEG your pardon, gentlemen, for returning to this subject of the application of the laws of Naudin-Mendel to the human species. I have previously discussed the question in my book *Maladies Familiales;* I have treated it in various magazine articles; I expounded it again at the International Eugenics Congress in London. I would not come back to it this time if it did not seem to me absolutely necessary to do so. These laws are the very foundation of studies on heredity; they constitute the clue which at last saves us from losing ourselves in a chaos of facts that at first sight are multiple, deceptive and contradictory; thanks to them, we may dream of establishing a rational science of eugenics; if they do not correspond to the facts, we have no basis on which to pursue our eugenic studies.

We must be very certain, then, of the legitimacy of their application to the human species. This legitimacy has very recently been once more called in question. Happily new data permit me to establish the laws this time, not by analogy, by generalization for man from observations on lower animals, but by direct demonstration.

Let me recall that as a result of the observations of Naudin and Mendel on crosses between varieties of the same species of plant, and as a result of more recent confirmatory studies, we thought we could consider the conclusions of their studies as definitely established. These conclusions were the *segregation of forms in the posterity of crosses* (Naudin), and the existence of *definite mathematical proportions between the numbers of descendants belonging to each of the segregated forms* (Mendel). As these laws had been verified in very diverse species of plants and animals, and for very diverse morphological, physiological and even pathological characters,[2] their extension to the human species might have been thought indisputable and undisputed, and their application to the field of eugenics, which I have tried to make, might have been thought wholly legitimate.

ATTACKS ON THE LAWS.

But the legitimacy of the application of the Naudin-Mendel Laws to the human species has not only been called in question, but violently disputed. An article by Dr. Guyenot, "Mendelism and Heredity in Man," published in his excellent journal *Biologica* (Jan., 1914), brings together a long list of objections of the most diverse application. These critics, it must be said, either limit themselves to the abuses which may occur in the premature application to particular cases, of principles which remain none the less unshakeable, or else waste their energy on the category of cases which I emphasized at London. In some cases the law of Mendel seems to fail, because various other factors add their influence to the hereditary factors governed by that law: such, for example, is the sexual factor (matriarchal heredity). To settle such cases, one method alone is practicable—

[1] Delivered before the Société Francaise d'Eugénique, May 6, 1914; translated from Eugénique (organ of the society), II, 5, 129ff., Mai, 1914.

[2] Hereditary ataxy in mice, rust resistance in wheat.

namely, the patient observation of numerous cases of inheritance in man.

Of course, the objection is at once raised that it is very difficult to observe the facts of heredity in man. The difficulties are indeed great, and there is every reason for insisting on them. The observation of facts of heredity can be much simplified in experimental plant and animal breeding, by judicious choice of the varieties with which one works, but no such expedient is available in the human species. It is very true, as critics have emphasized, that scientific prudence requires us, in dealing with heredity in man, sometimes to have a doubt about the real paternity of the subjects with whom we are dealing. It is very true that it is hard to push our researches farther back than two or three generations. It is very true that the ordinarily small number of descendants of any couple make the search for the Mendelian proportions deceptive. All of these difficulties are of the most inevitable sort. But because the verification of a law is difficult, shall we say that the law is untrue? Hardly! We are merely led to say that researches on a large scale are necessary to surmount the difficulties, and to verify or contradict the exactitude of the law. The work will be onerous, but may nevertheless be conclusive.

A good part of this work of collecting facts is now in process, thanks to the efforts of eugenic organizations. I do not refer to our own society, whose birth is too recent and whose funds too limited, to allow it to do such work; but you are familiar with the beautiful publications which make up the Treasury of Human Inheritance, issued by the Eugenics Laboratory of London, and also with the Drapers' Company Research Memoirs, published by the Biometric Laboratory of the University of London. In the latter series, Messrs. Pearson, Nettleship and Usher have just issued a big volume of pedigrees relating to albinism in man.

ALBINISM IN MAN.

Albinism is one of the variations which has been the most studied from the top to the bottom of the animal and vegetable scale, from the Mendelian point of view, and it has always shown itself to be recessive from that point of view. Here, then, is a good chance to see whether albinism obeys Mendel's Law in man, too; whether it is recessive, as it is with other living things. When it is realized that the work of these writers has brought together 691 genealogical trees, that many of them include three, four, five, or even six generations, that some of them include several hundred individuals, it will be admitted that the material on hand makes errors, if not negligible, at least much less important, so that their final influence on the results will be very slight.

In particular, the objection drawn from the small number of offspring of a single couple, in the human species, wholly disappears. If, instead of seeking the number of albinos among the offspring of a single couple, we seek the number among the children of some hundreds of couples, all of whom have given rise to one or more albinos, the result obtained will command some respect; and if it coincides with the Mendelian proportions, we have a right to assume that the law of Mendel is verified.

However, we do not obtain the large numbers necessary if we limit ourselves to investigating the direct descendants of albinos. For many reasons, albinos rarely marry; and their marriages are rarely fecund. Fertile marriages between two albinos are rare; in marriages between an albino and a normal the result is, according to the Mendelian law, variable according as the normal individual is homozygous (in that case there should be no albino offspring, according to the formula DDxRR = 100% DR), or as that individual is heterozygous (when we have DRx RR = 50% DR + 50% RR, or half of the children albinos). But in man, it is rare that we can say with certainty whether a subject of normal appearance is or is not homozygous. We can, therefore, get no help for our present study from statistics of children one of whose parents was albino and the other nor-

mal, even if the cases were sufficiently numerous, which they are not.

THE CRITICAL CASE.

But on the other hand, when two non-albino individuals have among their offspring one or several albinos, we can affirm, if Mendel's Law is exact, that these two parents are heterozygous DR; and we know that the proportion of recessives RR in unions between heterozygotes is 25 in 100, according to the formula DRxDR = 25% DD + 50% DR + 25%RR. In the pedigrees collected by Pearson, Nettleship and Usher, we shall therefore seek the cases where one or more albino children have been produced by normal parents; and we shall see whether their numerical proportion, relative to the total number of children born from those couples, accords with Mendel's Law.

It must be carefully noted that the theoretical figure, when we proceed thus, is not 25%, but a larger figure, separated the more widely from 25, in proportion as the number of children born to the couple is the smaller. For each of the children successively born to our heterozygous couple, there are indeed 25 chances in 100 or one chance in four that he will be an albino. But when the total number of offspring contains no albino, the case escapes our observation. If, for example, the phratry [3] consists of but one individual, the only phratries noted in our statistics are those in which this unique subject is an albino, and the proportion is therefore 100%. In phratries composed of two children, there is one chance in four that the eldest-born shall be an albino, there is also one chance in four that the second shall also be an albino, and consequently there is one chance in 4x4, or 16, that both subjects be albinos. On the other hand, there are three chances in four that the first-born be not an albino, three chances in four that the second shall not be an albino, either, and consequently 3x3 chances in 4x4, or nine chances in 16, that both the children be normal. But as these cases escape observation, there remain one phratry of two albinos in two children, and six phratries of one albino in two children, or eight albinos in 14 children—that is, 57 in 100. Continuing thus we find, for phratries of three, four, five, six, seven, eight, nine, 10, 11, 12, and 13 children, the figures of 43, 36, 33, 30, 28.8, 27.7, 27, 26.4, 26, 25.7, 25.5 (in 100)—a proportion that continually approaches the proportion 25 per 100, without ever reaching it.

Such are the theoretical figures, calculated according to Mendel's Law; we must now compare them with the figures contained in the genealogical work of Pearson, Nettleship and Usher. These figures are contained in the following table:

A No. of children in the phratry.	B No. of phratries observed.	C Total No. of albinos in phratries.	D Avg. No. albinos per phratry.	E Proportion of albinos in 100 children.	F Proportion of albinos per 100 (theoretical figures).
1	64	64	1	100	100
2	80	109	1.36	68	57
3	96	149	1.54	51	43
4	85	139	1.63	40	36
5	77	140	1.82	36	33
6	74	164	2.21	35	30
7	57	128	2.24	32	28.8
8	40	100	2.50	31	27.7
9	34	79	2.32	25	27
10	29	76	2.62	26	26.4
11	15	49	3.27	29	26
12	11	34	3.09	25	25.7
13	7	24	3.43	26	25.5

[3] For the sake of simplicity I thus designate the *ensemble* of brothers and sisters borne to the same parents. The English eugenists use the neologism *sibship* in the same sense, making use of the word *sibling* to designate each of the individuals making up a sibship, whatever be his or her sex.

It is obvious that, in a general way, the proportions found in the genealogies are quite close to the proportions calculated theoretically. It is noticeable that, in general, they are somewhat higher. It is not unnatural to conclude that some factor has come into play, which adds its influence to the hereditary factor ruled by Mendel's Law; should we invoke, beside the hereditary factor, a factor of *innateness*, as Lucas does? Perhaps, because it is certainly necessary that albinism should have appeared on some occasion, for the first time; perhaps this factor still exists, to add its influence to the factor of heredity. But to me another explanation seems more plausible. Note that the discordance only exists in the small phratries; it disappears in the phratries above eight subjects. I think it is because these researches do not represent the population in its entirety. I mean that the authors have gathered their material by collecting all observations published on the subject of albinism: now, it is very certain that not all cases of albinism are published, but only those which present some interesting particulars; among the interesting details which would lead to publication is the coexistence of several albinos in the same phratry, while an observer would easily pass without publication an observation relative to a single, isolated albino, unless he belonged to a very large phratry, in which case his isolation would itself be an interesting fact. In small families, the facts published by preference are those in which albinism appears relatively frequent; and it is in this manner that I should explain how the proportion of albinos found in small families is somewhat larger than the calculated expectation. It is probable that if the statistics could include all families in which albinism exists, the discrepancy—small, as it is—between observation and theory would be much diminished. We would then have only slight oscillations above or below the theoretical probability, as we have at present in the families of nine, 10, 11, 12 and 13 children.

To sum up: the figures brought out of the documents are in very close agreement with those required by the Mendelian law, or present only divergences explicable by the conditions under which the documents were compiled; and all these divergences are in the direction which the conditions lead us to expect.

We can even extend this agreement farther still. It is easy to calculate, from the mathematical law, the probability of the number of albinos in "albino phratries." Take, for example, the phratries of seven children. Calculation shows one chance in 14,198 that in these seven children there will be seven albinos; 21 chances in 14,198 that there will be six albinos; and 189, 945, 2,835, 5,103 and 5,103 chances in 14,198 that there will be five, four, three, two and one albinos in seven children.

Let us compare this calculation with the observation. In the work of Pearson, Nettleship and Usher, we find 57 albino phratries containing seven children each. One of these contains six albinos, four contain four, 18 contain three, 14 contain two and 19 contain one albino among the seven children. Calculating these figures on the basis of 100, to make comparison easy, we get the following table:

PHRATRIES OF SEVEN CHILDREN.

	Figures observed.		Figures calculated.	
	Absolute.	Percent.	Absolute.	Percent.
7 albinos	0	0	1	0.007
6 albinos	1	1.75	21	0.14
5 albinos	0	0	189	1.33
4 albinos	4	8.77	945	6.33
3 albinos	18	31.54	2,835	19
2 albinos	14	24.55	5,103	34.20
1 albino	19	33.33	5,103	34.20

I have arranged tables for the phratries of six, five, four, three and two children, in the same way.

PHRATRIES OF SIX CHILDREN.

	Figures observed.		Figures calculated.	
	Absolute.	Percent.	Absolute.	Percent.
6 albinos	2	2.70	1	0.029
5 albinos	2	2.70	18	0.52
4 albinos	5	6.75	135	3.89
3 albinos	19	25.67	530	15.57
2 albinos	20	26.02	1,215	35.05
1 albino	26	35.03	1,458	42.05

PHRATRIES OF FIVE CHILDREN.

5 albinos	2	2.83	1	0.12
4 albinos	1	1.41	15	1.81
3 albinos	13	16.88	90	10.89
2 albinos	26	33.77	270	32.68
1 albino	35	45.45	450	54.47

PHRATRIES OF FOUR CHILDREN.

4 albinos	1	1.17	1	0.57
3 albinos	10	11.76	12	6.85
2 albinos	31	36.47	54	30.85
1 albino	43	50.58	108	61.71

PHRATRIES OF THREE CHILDREN.

3 albinos	13	13.68	1	2.70
2 albinos	26	27.36	9	24.32
1 albino	56	58.94	27	72.97

PHRATRIES OF TWO CHILDREN.

2 albinos	29	36.71	1	14.33
1 albino	50	63.29	6	85.71

If these tables are studied it will be seen that the disc epancy between the observed and theoretical figures is not noteworthy except in cases where this difference can be explained by the remark I made that the figures of Pearson, Nettleship and Usher are not the result of a complete census, but of a collection of published cases, where the rarest instances figure in proportionately too large a number, and where on the contrary many common instances, such as that of a single albino in a family, do not figure. It will be noted that the discrepancies observed are always in the direction which this remark requires, and they are important only in the cases where their importance is explained by the circumstances under which the observation was made. That proves, then, the exactness of my explanation. On the whole, and taking account of these explanations, we may say that obser-

vation verifies the Mendelian proportions.

It seems to me difficult not to admit, as a consequence of these statistics, that albinism in man is recessive and obeys the law of definite proportions, established by Mendel.

The laws of Naudin and Mendel, then, are incontestably applicable to the human species, in this instance. Certainly, that does not prove that they apply equally to other anomalies. I should be very careful about drawing conclusions from this demonstration in albinism, about other family taints in man, whether they be of an anatomical, physiological or pathological nature. There will be no possibility of certitude, until each of these anomalies has been the object of an analogous study. However, if the case for albinism is proved, does it not at least render it probable that other anomalies behave in the same way, and should it not encourage us to pursue our researches in that direction?

Even before the discovery of the work, we knew that the mode of transmission of family defects presented curious particulars which allowed them to be classed in two groups: Féré proposed the name of *fraternal diseases* for those in which the heredity is collateral and discontinuous—that is to say, the mode of transmission proper to recessive characters; a second group, *parental diseases*, is transmitted on the contrary in continuous inheritance, in the manner of dominant characteristics. Is it not very probable that the inheritance of these diseases obeys Mendel's Law, the first being recessives and the second dominants? Shall we await a rigorous mathematical demonstration before trying to make any practical application of the principles which they involve?

POSSIBILITY OF APPLICATION.

In this respect, it is important to distinguish the practice of legal medicine from that of clinical medicine. Medico-legal truth demands absolute demonstration: I should take care, for example, in legal medicine, not to affirm a case of conjugal infidelity, if from the union of two albinos there was born, contrary to the Law of Mendel, a normal child; we are not yet well enough informed whether, in certain exceptional cases, extraneous factors may not interfere with the results which would be expected in such a case under the Mendelian Law.

But in the practice of clinical medicine, the case is different. There, we can not act as did the professor in the fable, and philosophize while the child drowns. The possibility of a danger, the probability of a benefit, is enough to give us not only the right, but the duty, of making the appropriate prescription as soon as possible: we thus have a chance of saving from this danger the families whose guidance is entrusted to us, or the hope of benefiting them.

It is from such a viewpoint that I formulated at the Congress in London some rules [4] which, in the present status of the science of eugenics, should be considered as allowing us to avoid the dangers to be feared in marriages of members of tainted family stocks, when these taints can be classified as to their mode of inheritance. I persist in thinking that these rules are of great value. For one of the diseases mentioned —albinism—a more rigorous demonstration has proved that they correspond to scientific truth. For the other diseases we have not yet, I admit, anything except a probability based on clinical observation which is often restricted, but often extended. This probability, however, is enough to make it impossible for us to disregard the rules which ensure the safeguard of strains of germplasm from family diseases.

[4] Following are the conclusions of my communication to the Congress of London, where these rules are formulated (they were also published at length in the *Monde Medical*, 1912, No. 459):

"To sum up, the study of heredity in family diseases permits us to lay down a certain number of rules which indicate the risks incurred in any given marriage. Such study permits us to withdraw the total prohibition of reproduction, demanded by writers who have studied the question only superficially—a measure too draconian ever to have been enforced. We are now in a position to substitute for such prohibition, advice that is more likely to be followed, because it leaves to the unhappy members of tainted families the possibility of leading a normal life,

ORIGIN OF THE DATE PALM

Fossils Found in Texas Indicate that it May be Native of America—Known Only in Orient in Historic Times—Its Connection with Semites and Its Religious Importance—Influence as Factor of Natural Selection.

THE EDITOR

FOR many years botanists have wondered where the date palm as a distinct species originated. Sentiment has seemed to incline toward North Africa as its first home, but the precise locality suggested has varied all the way from western Morocco to eastern Egypt; while the German botanist Schweinfurth declared his belief that *Phoenix spinosa* of tropical Africa was the species most nearly like the ancestral type of date palm, if indeed the latter was not a direct descendant of *P. spinosa*. The Italian botanist Odoardo Beccari, who is by general consent the authority on palms at present, considered the Persian Gulf to be the home of the date palm, and set forth[1] his position in such a logical way that the question seemed for a time to be settled.

"It is only in the orient," says Beccari, "that the true home of the date palm is to be found; in the orient where the true center of formation of the genus Phoenix is located and where the wild species most closely related to the domestic one—namely, *Phoenix sylvestris*—exists."

Beccari then elaborates his evidence in more detail. The home of the date palm must first be generally fixed by finding the home of its whole genus. The present distribution of Phoenix indicates that this must have been in India, according to Beccari's way of thinking. Next, the home of the date palm must be more definitely located, by a consideration of the physiological and morphological characters of the plant. We have a palm which thrives only in subtropical regions with scanty rains, but demands much moisture about its roots, and is remarkably tolerant of alkaline soils. Beccari thinks these facts may be taken to mean that the ancestral home of the date palm possessed similar characteristics. He therefore seeks its origin in a region of subtropical climate and

[1] Beccari, O. Malesia, III, 359. Firenze-Roma, 1886.

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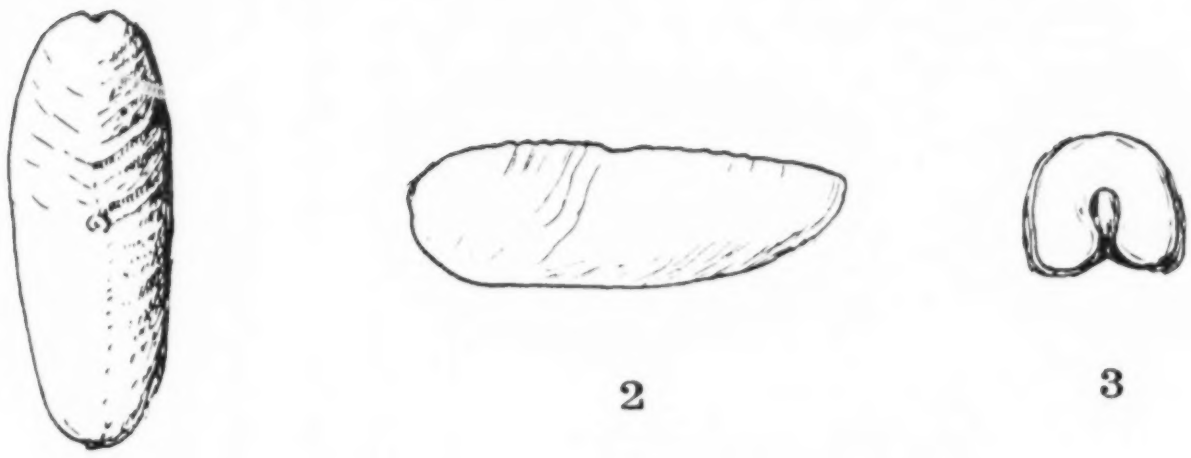
placing them under no restraint except that of judicious choice in marriage mating. These rules can be summarized as follows:

"*Diseases of parental heredity*: individuals who show no traces of the disease should not be the objects of any restrictive measures whatever; nor are consanguineous marriages particularly to be feared.

"*Diseases of matriarchal heredity*: descendants of affected males should not be the objects of any restrictive measures; individuals descending from the common stock exclusively through the female line may themselves be attacked by the disease, if males, or may transmit the disease to male offspring, if females; consanguineous marriages are not particularly dangerous.

"*Diseases of fraternal heredity*: the malady may be transmitted in a latent state by all descendants of the affected subjects, or by their collaterals; but its chances of reappearing are much smaller than in the two preceding categories, these first two being of the dominant type. On the other hand consanguineous marriages, no matter how remote the degree of kinship, may be very dangerous in this latter category. As the disease may remain latent through a series of generations, one must go high in the ascendants, far in the collaterals, to be sure that an individual coming from an affected stock will marry into an untainted one. In such 'outcrosses,' the chance of a return of the disease becomes very slight." To this I added:

"In closing, I do not want to slight the fact that application of the rules thus established offers difficulties in many cases. The mode of inheritance has not yet been sufficiently determined for many family diseases. Some of them seem to fall in two classes. In such cases, it would be prudent to double the precautions."



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SEEDS OF THE AMERICAN DATE PALM

These fossil seeds were recently found in a Tertiary deposit of Texas, and give the first indication that the date palm, now confined to the eastern hemisphere, was at one time an inhabitant of America. They are considerably larger than the seeds of most commercial varieties of date known at the present day, but can be matched by seeds of occasional palms which have grown from seed, and show reversion. After Berry. (Fig. 6.)

scanty rainfall, close to the sea or some other body of salt water, this being a necessary condition to furnish the moist but saline subsoil for which the palm is evidently adapted. "This region," he concludes, "can only be sought to the west of India, in Southern Persia or on the Arabian coast of the Persian Gulf.

"To locate the original home of a cultivated plant, however, and to admit that it exists there today, are two different things.

WILD FORM NOT KNOWN.

"It is my belief that the date palm can not be found today in a wild state, because the nutritive qualities of its fruit are so great and the natural protection afforded to the flowers and vegetative parts is so slight, that it could not exist except by the aid of man. . . . The date palm can not be found except linked to the white human race. . . . No one should underestimate the importance which it must have exercised on the populations among which it prospered, in the preponderance which such populations were able to attain over others, as a result of the nutritious food, wholesome and plentiful, which the date palm furnished them."

But the recent discovery in a Tertiary deposit of eastern Texas of fossil dates has brought in an entirely new phase of the question, and strikingly illustrated the danger which surrounds all attempts to speculate on the data presented by systematic botany. Even scientists who looked on the western hemisphere as the original home of agriculture have never, so far as I know, suggested that the date palm was one of the products which America has furnished the world; yet the find of dates dating back several millions of years throws the burden of proof on those who would now hold otherwise.

The discovery of these remains was announced by Edward W. Berry of Johns Hopkins University in the *American Journal of Science* (May, 1914). He writes:

"The considerable range of species of Phoenix-like palms in the south European Tertiary has led to the expectation of their discovery in our more tropical southern Tertiaries when these should have been thoroughly explored, just as the Bread-fruit, Cinnamon tree and Nipa-Palm have been found; nevertheless, the actual proof of the former existence of a date palm in the Western Hemisphere is one of the more spectacular incidents of the paleobotanists' work, since it is likely to attract more attention from botanists and geologists engrossed in their own special lines of study than a tome of admirable descriptive paleobotanical work. In order that the presence of the date palm in

the American Tertiary may not remain unknown until my monographic studies of our southern Tertiary floras are published, which will be a number of years hence, I am prompted to publish the present brief note.

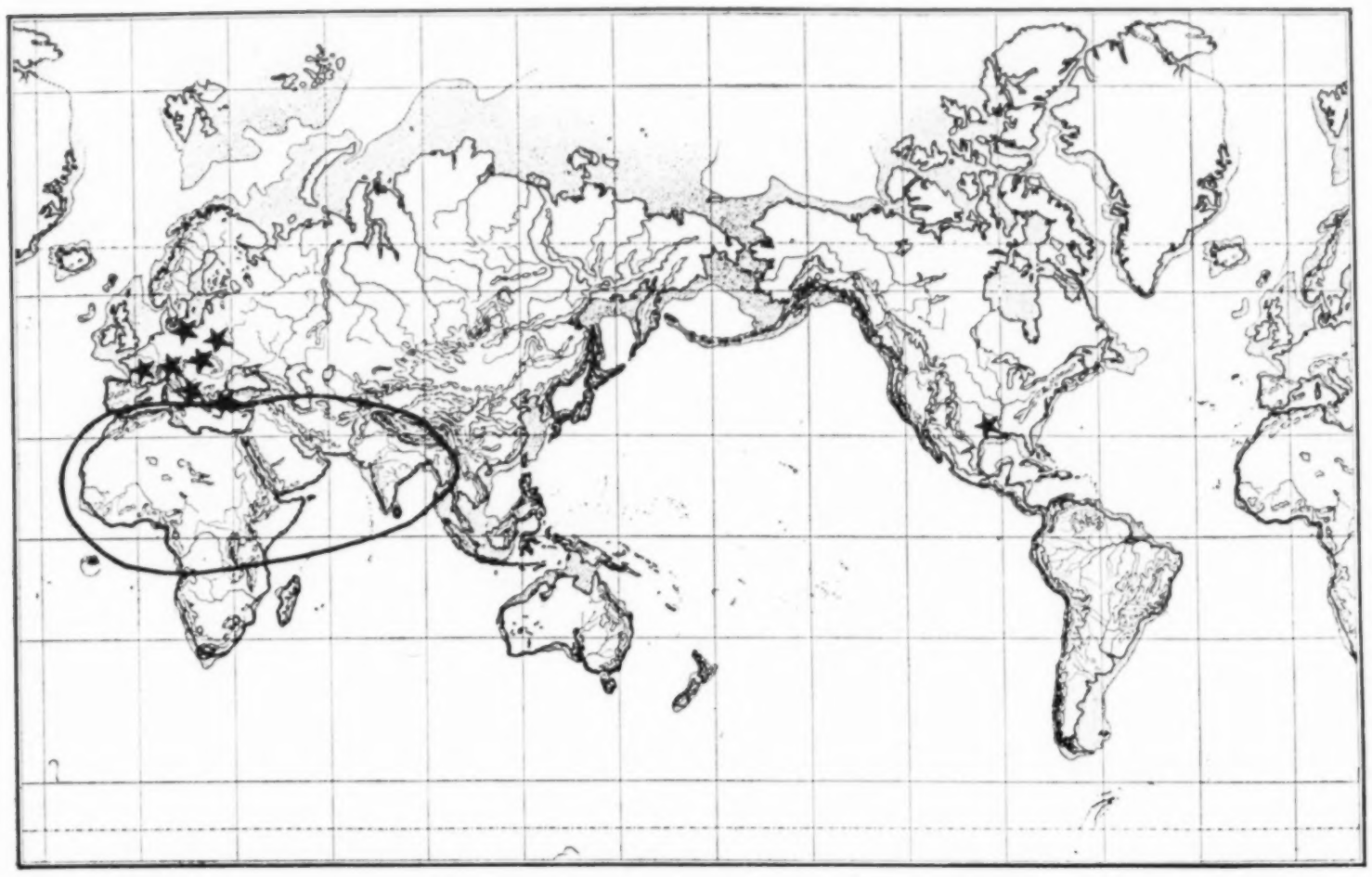
THE FOSSIL FRUIT.

"In the course of my studies for the U. S. Geological Survey and under the supervision of Dr. T. Wayland Vaughan, I have had the good fortune to receive collections of fossil plants from eastern Texas made under the direction of the veteran geologist, E. T. Dumble, now associated with the Southern Pacific Company. The material on which the following note is based was collected by Chas. Laurence Baker in Trinity county, Texas, and while not abundant contains both large and small seeds and a cast of the entire fruit of a new species of Phoenix-like palm which may with propriety be referred to Brongniart's genus Phoenicites. I propose to call this species *Phoenicites occidentalis*. It may be described as follows: Fruit, as preserved in a coarse gray sandstone, an oblate spheroid about 4 cm. in length by 1.5 cm. in breadth. The surface is longitudinally wrinkled, due possibly to dessication before preservation, which may also make the dimensions as given under what they were in life. The flesh was relatively thin compared with the cultivated date and must have been of considerable consistency and fibrous rather than of the soft and almost fluid character of some of the modern varieties of the latter. The seed was relatively large—in the above-mentioned specimen it is rounded at both ends, about 3 cm. in length, nearly circular in transverse section and about 1 cm. in diameter. A smaller specimen shows a length of about 2.5 cm. and a diameter of 8 mm. The larger of these seeds shows the central hilum, the deep longitudinal sinus on the opposite side, the transverse lamellated structure exactly comparable to that of a modern date seed and the finely corrugated surface coat identical with that of a dried seed of a modern date. The smaller specimen, while not so perfect, shows the general form and sinus and the lamellated structure. There can be no doubt that these remains are those of a Phoenix-like fruit and it is confidently expected that the foliage will eventually be discovered, in fact some of the fragments of palm-rays found at this and other horizons in our southern Tertiary may represent this foliage. Petrified wood of several species of palms is exceedingly abundant in these beds, and while the study of palm woods has not progressed to a point where one can speak with certainty of the generic relations of the petrified woods, it is significant that wood of several different species occurs at this horizon.

FOSSILS FROM EUROPE.

"While the geologic record is confessedly incomplete, a number of fossil species of Phoenix-like forms have been described, in fact there are more fossil than recent species. These are usually referred to the genus Phoenicites of Brongniart as in the present case, although some students refer them directly to the genus Phoenix of Linné. The previous fossil occurrences are all European and are based on leaves and inflorescence. In 1886 Conwentz described a flower preserved in perfection in the Baltic amber and the staminate inflorescence of another species is associated with splendid leaves in the Eocene of the Paris basin. The oldest known comes from the upper or middle Eocene of the Paris basin, while in the succeeding Oligocene period the remains of date palms are abundant in Germany, Bohemia, and especially in northern Italy. They are present in the early Miocene of France, Switzerland and Croatia. A species is recorded from the west coast of the Adriatic in Pliocene times and the presence of a well-marked form which Drude calls *Phoenix dactylifera fossilis*, since it is so much like the existing date, is found in the Pleistocene deposits of the volcanic island of Santorin in the Aegean Sea. The latter occurrence indicates that the date palm was endemic in at least a part of southern Europe until comparatively recent geologic times.

"A consideration of the ecology of the date and of other existing species of



THE RANGE OF THE DATE PALM

The present range of the date palm is in the territory circumscribed by the heavy line. No account is made of America, since the palm has only been introduced here within a relatively recent time. The stars show localities from which fossil remains have been taken, indicating that in the prehistoric period the palm was much more widely spread than at present. After Berry. (Fig. 7.)

Phoenix, at least two of which are coastal types, indicates that the geologic ancestors were not necessarily desert types, but inhabitants of coast and stream-banks where the water-table approached near enough to the surface to become available for their root system. When corroborated by the associated forms of vegetation they may indicate hot climates with a scanty rainfall as they probably do in east Texas and it seems certain that temperatures could not have gone below 18° C. without being fatal.

"*Phoenicites occidentalis* comes from a cut on the International and Great Northern Railroad in southern Trinity county, where a spur to the government lock leaves the main line. The outcrop is referred to the Catahoula formation, which in this region is of late Eocene or early Oligocene age."

MIGRATION OF THE PALM.

Why the date palm became extinct in America, and how it spread to the Eastern Hemisphere, one can hardly guess, but as such a history is matched by that of numerous other plants and animals known to us, there is nothing improbable in it. As far as our historical record goes—and for the date palm it goes back very close to the beginning of history—the palm has been associated with the Semitic peoples, so that it has come to be considered an integral part of their culture.

Far earlier than any of our written records we must picture the date palm as established in the Persian Gulf and Babylonia, and forming an important part of the food of the inhabitants of that region. Its fruit in that period doubtless consisted of much seed and little flesh, like the Texas fossil and like the fruit of *Phoenix sylvestris* and many seedling dates today, for in that early period we can hardly suppose that the propagation of superior varieties by offshoots was practiced. By the time, however, of the famous Hammurabi (c. 1958–1916 B. C.) there is evidence that propagation by offshoots was the customary means of starting a plantation. The sixtieth paragraph of that monarch's code of laws provides that, if a man lease his garden to another to plant as an orchard, he shall let it without rent for four years, but in the fifth year the owner shall have half

the crop. There are several contracts of the period of Hammurabi, which relate to orchards, all of which mention dates as the principal, indeed the only fruit, crop. The natural inference is that orchards in Babylonia always contained dates, and that planting an orchard meant getting palms ready to bear. Four years, then, was the time allowed for this—a limit that makes vegetative propagation absolutely necessary.[2] Indeed, if the Babylonians could get a paying crop in the fifth year, they did better than most Arab cultivators do today in Babylonia, although Californians expect to do as well as that, by the use of scientific methods.

Scholars now believe 5000 B. C. to be as early as any settlement in Babylonia can be traced. Even at that time, however, dates must have been one of the most important products, as they perhaps were to the Semites in their earlier Arabian home some thousands of years previously. When we first begin to get written records from Babylonia, we find that the palm holds a prominent place. One of the oldest tablets in the world is a Babylonian fragment now in New York, which may go back to 3000 B. C., and contains a rude picture of a date palm, in connection with a memorandum of an offering to some temple.

THE DRINK OF LIFE.

At that period, and doubtless far earlier, the palm was valued not only for its fruit, but perhaps almost as much for the beverage which its sap furnished. This appears in early inscriptions under the name of "the drink of life;" "as far back as the period of the formation of the cuneiform script this was the name given to the date wine of Babylonia," says Sayce. Beccari interestingly discusses the way in which the possibility of producing an intoxicating liquor from the palm came to be known. "That primitive man could at a very early period discover the manner of obtaining a fermentable liquor from the date palm is easily understood," he thinks. "When he learned that by cutting out the terminal bud of the palm he obtained a delicious food, he also found that as a result of that operation, a sweetish liquid flowed abundantly from the wound. Nothing more natural, in a country where water is scarce, than that this liquid should have been caught in some kind of a receptacle and used for drinking. But in the meanwhile the liquor fermented; and thus perchance, earlier than the juice of the grape, man may have learned the method of making alcohol, and to feel the effects of its inebriating power."

Beccari is no doubt right in emphasizing the tremendous importance this discovery must have had, as an agent of natural selection. While palm wine is not to be compared with distilled liquors, in alcoholic content, it yet contains so much alcohol, when fermented, as to be decidedly dangerous. The French have recently prohibited its manufacture in Algeria, partly because the natives were destroying their plantations in order to satisfy their appetites for alcohol, but largely because the beverage led to incessant breaches of the peace. The influence of alcohol in injuring germ plasm is becoming better attested each year, yet most of the germ plasm now exposed to its ravages has gone through centuries of natural selection, when the strains which showed the least resistance to it were cut off. The havoc that must have been wrought by palm wine, when first discovered and used by a people who had never undergone any selection against alcohol, can only be imagined by remembering how the American Indian fared under similar circumstances.

THE MYSTERY OF SEX.

Added to its value as a producer of food and drink, the date palm possessed another element of intense interest to the dwellers of Babylonia and the shores of the Persian Gulf in its dioeciousness—female and male flowers being borne on different palms. The

[2] See R. F. Harper, The Code of Hammurabi, p. 53, 1904, and Schorr, Urkunden des altbabylonischen Zivil-und Prozessrechts, pp. 189–194, 1913. I owe this and numerous other valuable suggestions to Dr. Geo. A. Barton of Bryn Mawr College.

POLLINATION OF THE PALM

Conventional design of a type particularly frequent in the palace of Ashurnasirpal (883–859 B.C.) at Nimrud (Ninevah). While orientalists do not agree on the interpretation of the figure, there is reason to believe that the winged deity represents the palm god, and that he is holding in his right hand a male inflorescence, with which he is fecundating the female flowers. Because of its dioeciousness, the palm early came to symbolize the reproductive force of nature, for the Semitic peoples, and thus assumed an important place in their religion. After Siret. (Fig. 8.)

mystery of reproduction always occupies the minds of primitive peoples, and here was a particularly striking case, where the process of fecundation could be watched, or even carried out by the agency of man, and where the difference in result, as the female was or was not pollinated, was marked. The date palm, already valued as producing the best food, and the "drink of life," come to symbolize the creative force of Nature, and the next step, details of which are not wholly clear to us, led to its firm establishment as the "tree of life," an object of actual worship—or at least, to its identification

with that primitive Semitic goddess, who herself symbolized the creative force of nature.

We are still dealing with a very remote period of human history, and the records which have come down to us are fragmentary, but we have enough to get a general view of the date palm as the center of a cult of immense antiquity. Our earliest records show this cult centered in the town of Eridu, only a few miles from that Ur of the Chaldees (Mughayr of modern maps) whence Abram migrated, and at present about 90 miles from the head of the Persian gulf. It was then a seaport, however, and calculations of the rate at which the Tigris and Euphrates have deposited silt indicate that it must have been a seaport about 7000 years before Christ. This was long before the immigration of the Semites, ancestors of the Hebrews and Arabs, who later spread over Babylonia. Their station was perhaps at Eridu, which owned its renown less to that fact, however, than to its being the home of the oracle-tree, the Tree of Life, whose position in a garden near the town marked the center of the world. This tree was a date palm.

"The garden and its mystical tree were known to the inhabitants of Chaldea in pre-Semitic days," Sayce notes.[3] "A fragment has been preserved of an old Accadian-Sumerian hymn with a Semitic Babylonian translation attached to it, which tells us something about them. The hymn begins as follows:

> In Eridu a palm-stalk grew overshadowing: in a holy place did it become green;
> its root was of bright lapis which stretched toward the deep: [before] the God Ea was its growth in Eridu, teeming with fertility:
> its seat was the [central] place of the earth; its foliage (?) was the couch of Zikum, the [primeval] mother.
> Into the heart of the holy house which spread its shade like a forest hath no man entered.
> [There is the Home] of the mighty mother who passes across the sky.
> [In] the midst of it was the god Tammuz.

"The sacred tree whose branches reached the heaven while its roots were nourished by the primeval deep was the tree which supported the world. It was emphatically a 'tree of life' and is accordingly represented time after time on the monuments of Babylonia and Assyria."

When the Semites from Arabia invaded Southern Babylonia, at a date beyond the scope of historical knowledge, they must have found the date palm already established there, even if not cultivated; Barton, indeed, suggests[4] that they established themselves at Eridu as their first station, because they found at that place their old friend, the date palm. If this be the case, it may be assumed that the culture of the palm in some of the valleys of the Arabian shore of the Persian gulf represents the oldest form of agriculture in that part of the world. There is reason to believe that in their earlier, Arabian home the Semites had already accorded divine honors to the date palm; and in Babylonia the cult seems promptly to have become widespread and well organized. It spread gradually to the north, finally reaching the Phoenicians and residents of Syria; in all these regions the Tree of Life became a regular factor in decorative art, reaching its greatest vogue, perhaps, in the kingdom of Assyria about the ninth century before the Christian era, when the huge palaces of Nimrûd (Ninevah) were constructed, in which the palm tree and the supposed palm god figure at every turn. The Tree of Life, sometimes so conventionalized as to be almost unrecognizable, was also used in the interior decoration of temples, on city gates, on royal vestments, seal cylinders, and everywhere else that the artist could bring it in. The exact interpretation of the designs has given rise to much controversy; it is not of great importance to us, so long as we know that it is the date palm which is represented.

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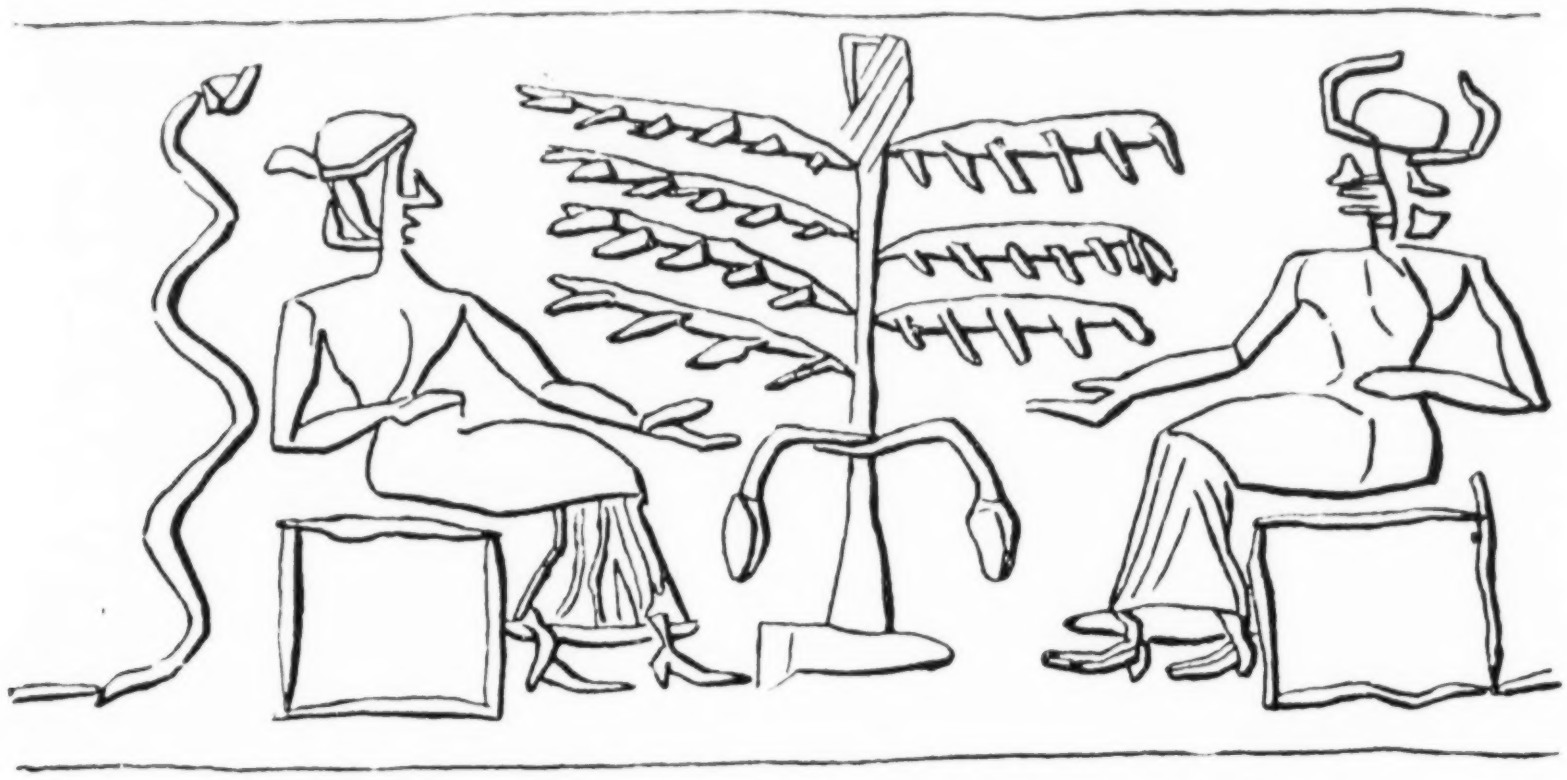
[3] Sayce, A. H. The Higher Criticism, p. 100. When Sayce wrote, it was still believed that the Semites were late arrivals in Babylonia, and that the original inhabitants were the Sumerians, a race which probably came down the mountains to the northeast, and has been thought by some to be an Aryan, by others a Mongol or Turanian, stock. Eduard Meyer in his Sumerier und Semiten in Babylonien, 1906, proved to the satisfaction of most scholars that the Semites were the original inhabitants.

[4] Barton, G. A. A Sketch of Semitic Origins. New York, 1902.



THE SO-CALLED ADAM AND EVE CYLINDER

Design from a seal cylinder now in the British Museum. It is of unknown date, but apparently belongs to an early Babylonian period. It has given rise to more controversy than any other seal cylinder ever found, one school of orientalists, led by George Smith, seeing in it a representation of Adam and Eve before the Tree of Life, with the serpent at the left, while others, including Menant and Ward, think it has no reference to the account of the fall of man contained in Genesis, but represents rather two deities of production, Ningirsu and Bau. Whatever be the interpretation, it is at least obvious that the tree in the center is a date palm. (Fig. 9.)

E. B. Taylor[5] is credited with the enunciation of the theory that the designs symbolized the artificial pollination of the palm. The interpretation was generally accepted, and a late legend was also brought forward, which explained the figures by the story that they were gods which had taught man how to produce dates by artificial fecundation. Bonavia, in his "Flora of the Assyrian Monuments," considered them to be the winds, agents of pollination in nature. Siret[6] and others interpret them as human personifications of the palm itself—the palm-god, the palm in the form of a god with a human figure. Siret thus explains the fact that they are usually winged:

"The essential morphological character of the palm, which distinguishes it among all other trees, is its leaves; in anthropomorphizing it, these could not be suppressed; but as leaves could not very well be represented on a human body, these leaves which are not very dissimilar to feathers, are represented as feathers, which are grouped together as wings. Such a grouping in itself is not arbitrary: look at a row of palms carrying all their leaves. It will be noted that horizontal leaves are rare, because as soon as they reach that position, their weight rapidly pulls them down; accordingly they divide into two groups, one pointing upward, the other downward. Such are the wings of the Assyrian deities, the one raised, the other lowered."[7]

IN THE GARDEN OF EDEN.

As we approach nearer to strictly historic times, and the records which have come down to us become fuller, we get more and more light on the importance of the palm in the life of Semitic peoples. The most interesting manifestation of it, seen by some orientalists, is in the story of the Garden of Eden related in the first chapters of Genesis.

We know that Edin was, from the

[5] Nature, June 23, 1890; Proc. Soc. Bib. Archeol., 1890.

[6] Siret, Louis. Les Cassitérides et l'Empire Colonial des Phéniciens. L'Anthropologie, XX, 292. Paris, 1909

[7] As a matter of fact, the very earliest seal-cylinders, in representing winged animals and man, show them merely with palm leaves attached to their shoulders. There can thus be little doubt as to the significance of the wings in the minds of the later artists.

dawn of history, the name for the alluvial plain of the Tigris and Euphrates rivers at the head of the Persian gulf. The Semites and Sumerians alike used it. Equally widespread, as we have seen, was the tradition of a Tree of Life at Eridu in Edin—a tradition which survived in tangible form down to a late day, through the presence of an oracle-palm on the same spot. Now the theory put forward by Sayce, Hommel and other orientalists is that the Biblical account of the garden of Eden is derived from this same tradition of venerable antiquity, about the Tree of Life at Eridu.

"The garden with the tree of life in the midst was planted 'in Eden eastward,' for such is the correct rendering of the Hebrew text," declares Sayce, "and not 'eastward in Eden' as the Authorized Version has it. Not only the garden, but Eden also, lay to the east of the land where the writer lived—The garden stood hard by Eridu, 'the good city'—and thus in the very region where the salt 'river' of the Persian gulf was divided into its four heads" mentioned[8] in Genesis II. 10-14.

Not all orientalists admit that the date palm of the garden in Eden at Eridu was the origin of the Tree of Life and Tree of Knowledge of Good and Evil of Genesis; but at least there can be no doubt that the date palm remained an object of particular veneration to the Hebrews after they left Babylonia for Palestine. It was a chief motif in the decoration of Solomon's temple, while its sacred character is suggested by the fact that the prophetess Deborah had her seat under a date-palm, from which, inferentially, she derived inspiration. Barton sees in the Feast of the Tabernacles a survival of an earlier Semitic feast at the time of the annual date gathering.

AMONG THE PHOENICIANS.

Far before this period of the Hebrew kingdom, the Phoenicians possessed the cult of the palm, and carried it with them on their trading voyages. Numerous plaques and pieces of pottery have been unearthed in France and Spain, bearing date palm symbols, while in a domed sepulchre at São Martinho, Portugal, considered to date from the late Stone Age, a limestone cone was found identical with the burnt clay cones made in Babylonia and Assyria as images of the fecundating spathe of the male palm. These relics can be ascribed with a good deal of certainty to the visits of Phoenician ships in search of tin; while their influence in shaping the religious thought and forming the myths of all the peoples of the Mediterranean seems to many writers to have been great. Siret has elaborated this point ingeniously and interestingly, but it is too far from the field of genetics to warrant amplification here; I need only say that he finds traces of the palm cult in nearly all the Grecian deities, one particularly attractive conjecture being his explanation that the story of the visit of Zeus to Danae in the form of a shower of gold is merely a modification of the idea of the male palm fecundating the female with its shower of golden pollen. The case of Leto (Latona) who gave birth to Apollo beside a palm tree in the island of Delos, is a curious instance of the survival of the palm cult, from his viewpoint; and it is still more curious when one recalls that the legend, slightly changed, was applied to the birth of Jesus in the apocryphal "History of the Nativity of Mary and the Infancy of the Savior," which Muhammad, much later, seems to have used in the Koran as the source of his own account of Christ's birth under the palm tree, and the appearance of the angel Gabriel who bid Mary eat the fresh, ripe dates to refresh her soul. Tisdall ascribes[9] the story to an Indian origin, pointing out the markedly similar circumstances surrounding the birth of Buddha under a satinwood[10] tree, according to legend;

[8] Hommel identifies the river Hiddekel of Genesis with Khadd Daqlah, "The Valley of Date Palms" on the Arabian shore of the Persian gulf not far south of the present mouth of the Euphrates and Tigris rivers. Hiddekel is by most scholars taken to mean the latter of these two great rivers.

[9] Tisdall, W. St. C. The Original Sources of the Qur'an, p. 164. London, 1905.

[10] *Chloroxylon sweetenia*, D. C. Rutaceae.

THE GODDESS ISHTAR AND PALM

"There is hardly a more beautiful and elaborate Assyrian cylinder than one in the British Museum which represents the armed Ishtar," says W. H. Ward (The Seal Cylinders of Western Asia, p. 248). She is here shown as the goddess of war, standing beside the palm. Originally, in the opinion of many orientalists, Ishtar (Astarte) was the goddess of fertility, and identified with the date palm, which at a very early time seems to have received almost divine honors from the Semites—a condition of which traces can be seen throughout the later Arab and Hebrew history. This and the preceding design are from Jastrow, Bildermappe zur Religion Babyloniens und Assyriens. (Fig. 10.)

but in view of the sacredness of the date palm in all times, it is by no means clear that we should abandon the idea that this myth represents a late out-cropping of the palm-cult, rather than a borrowing from Indian literature.

All this is wandering far from the culture of the palm, yet the sacred character with which the early Semites invested it is too striking to be ignored. It is found in many sources. Tabari, an early Arabian chronicler, for instance, refers to a sacred date palm at Najrân, in southern Arabia, which was treated in all respects as a god; the residence of Al Uzza, one of the principal deities of pre-Muhammadan Arabia, was in a grove of palms at Nakhlah, a name which itself means palm tree; while an interesting light is thrown on the Biblical story of the Garden of Eden, and the accounts preserved for us of the tree of life at Eridu, by a passage in the oldest portion of the book of Enoch, in the version of the Ethiopians—a people of Semitic relationship. This passage, which probably dates from the second or third century before Christ, describes a visit of Enoch to Paradise, and relates that he found there the Tree of Life—and it was a date palm.

BAAL, THE PALM GOD.

In the heathen gods of whom we have some Bibilical account, it is frequently easy to see traces of the date palm cult. Few of them are better known to us than Baal; and the word *baal* even today, in classical Arabic, means an unirrigated palm tree. The connecting links between this fact and the time when Baal was looked upon as the god of unirrigated land, in contrast to Ishtar or Astarte, who was the primitive Semitic goddess of the palm, of fertility and fecundity, are traced with skill by Barton. No wonder, with such unbroken traditions, that the palm has always been looked upon with veneration by the Arabs, the purest of modern Semites; so that Muhammad declared it to have been created from the soil left over after the creation of Adam; and no wonder that the Arabicized Berber in remote Morocco even today mutters an Arabic prayer as he performs the important

operation of pollinating the female inflorescence by shaking over it and tying in it a few sprigs from the male flower.

Turning again to genetics, the outstanding fact in the culture of the date palm is the immense number of its horticultural varieties, and the antiquity of many of them. It is probably safe to say that there are not less than 5000 named varieties, in the subtropical regions of the world, and we have records of a number of them in Arabic literature, which prove them to be at least 1300 years old. During all this time they have been propagated vegetatively; nevertheless, Arabs declare that some of them have undergone large changes in the intervening centuries. The evidence at hand is not sufficient to constitute proof, and it may be that earlier varieties have died out and their names been assigned to other varieties with different characters. Personally, however, I think we must admit the possibility that some of the varieties have undergone changes analogous to those bud variations which have played so important a part in the history of the navel orange and many other fruits. It is not difficult to imagine an offshoot varying from its parent; when this was planted, if the variation was found to be favorable, it would continue to be propagated until the new type had supplanted the old one, without any change of name.

The fewest varieties (and in my opinion the best[11]) are found at present in the Persian gulf and Babylonia. All over the world the varieties are found to be quite local in distribution, but when one reaches North Africa, their number is greatly augmented, through the multiplication of chance seedlings. Darwin, to emphasize the way in which "organic beings of all kinds, when domesticated or cultivated, have varied," noted that "in the deserts of northern Africa the date palm has yielded 38 varieties." If he had multiplied this number by 10, he would still have been below the truth. There are probably a hundred varieties of commercial importance there, and a host of minor ones, almost every chance seedling in some districts being given a varietal name, if it happens to be a female. In Spain, the confusion becomes so great that varieties can scarcely be said to exist, each palm being a variety by itself. This seems always to have been the case in Spain, even in the time of Pliny, and may be confidently ascribed to propagation by seed, without sufficient care in selecting, rather than to the climate or any other environmental influence.

[11] Exception should be made in favor of Deglet Nûr, "The Date of the Light," a variety which originated as a chance seedling near Tuggurt in the Algerian Sahara 300 years ago and has since become recognized throughout North Africa as the standard of excellence. In the extreme desert conditions which it requires, it is perhaps as good as any variety in the world. Orthodox Arabs consider the dates of Medina, the prophet's home in Arabia, to be the world's finest, but until they have been studied by some competent pomologist, this verdict must be ascribed largely to religious enthusiasm, fostered by the legends connecting Medina dates with Muhammad. See Popenoe, Paul, Date Growing in the New and Old Worlds, 1913.

The Power of Heredity

Wise reform will not fail to recognize the force of heredity, whether for the continuance and multiplication of human ills, or for their diminution. It will do but little good to work for individuals here and there. Such conditions must be created as will redeem the human life-stream itself. It may be that the greatness of this task will stagger the thought and shake the courage of some. It is scarcely to be denied that the study of human nature as conditioned by heredity and environment is depressing in its initial stages. It makes humanity seem like clay in the hands of an inexorable and remorseless potter; but it will save an immense waste of time, effort and means, and, by and by, the depression will change to hope, as it is seen that the same law which necessitates degeneration under certain conditions, under other conditions works regeneration.—Rev. Amory H. Bradford: Heredity and Christian Problems (1895).

STUDY OF OLD AMERICANS

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OF THE many ethnic groups which are now entering into the formation of the American nation, the least known to science is that of the old white American. By the "old American" is meant the lineal descendant of American parentage, on both the father's and mother's side, for at least three generations; in other words, he who is not merely himself a native of the United States, but whose father and mother and both grandfathers as well as both grandmothers, were born in this country. This old and most important stock has never been studied exclusively. How strong is it in numbers? What physical changes, if any, have been wrought in its representatives by the new environment, the more strenuous mode of life, and the mixture of the various elements of which it is composed? Has it been changing so far as its anatomical and physiological characteristics are concerned harmoniously with the old world stocks from which it arose, or has it progressed differently? Does it tend towards a new subtype of the white race, as has often been suggested? What are the average stature, weight, head and chest dimensions, temperature, pulse rate, respiration and muscular strength of these old Americans? What the prevailing color of their eyes and hair?

In order to approach a definite answer to these and other questions which are of wide national interest, as well as scientific importance; and in order also to establish much needed standards for future comparisons, there are being carried out in the Division of Physical Anthropology of the U. S. National Museum, a series of scrupulously careful tests and measurements on healthy adult Americans of three or more generations, of both sexes, and of between 24 and 60 years of age. Persons fulfilling the requirements indicated above and wishing to forward the investigations in question are respectfully invited to present themselves, when convenient, for examination. The study, to be of real value, must extend over at least 200 men and 150 women, and it would be difficult to reach these numbers without the voluntary aid of those interested. No selection of subjects is called for outside of the above named stipulations, namely: that they shall be healthy, between 24 and 60 years of age, and on both sides American for at least three generations. The examinations are conducted under my own direction, and those who wish to present themselves for the measurements may do so at any time between 9.00 and 4.30 p. m., or by appointment after 4.30. The whole examination lasts but a little over a quarter of an hour, and no unusual exposure of the person is called for, with the exception of removing the shoes while the height of the body is measured, and in ladies the loosening of the hair for the measurements of the head. No names will be published in the final analysis and publication of the data. The original data will be kept in the U. S. National Museum and will be available to all of those who have been measured, and to their children.

The measurements comprise those of stature, head, face, chest (over the clothing), ear, hand and foot; tests are made of the muscular strength; the temperature, pulse and respiration are recorded; and the examination terminates with a few observations of the color of the hair, eyes, and the most distinguishing marks of the features.

The laboratory of the Division of Physical Anthropology is located in the new building of the National Museum; telephone number, Main 1811, branch 89.

A DEGENERATED ROSE BLOSSOM

Every horticulturist knows that the floral organs of any plant, such as the sepals of the calyx, the usually bright-colored petals, stamens and pistils, are all only so many modified leaves, and that under certain conditions leaf-buds can be turned into flower buds, at an early stage of their existence. Thus, by crippling the plants, gardeners force azaleas or camellias to produce flowers from the buds which the plants had intended to produce only leaves. The rose is a particularly good plant in which to trace this development, for it from time to time throws out flowers that fail to attain their normal development, and are nothing more than modified leaves. A bush on my estate has been behaving most irregularly for two years, always sending out freak flowers under certain weather conditions. Sometimes the roses are only half developed, just as if they were cut in two. Last spring it produced several twin flowers, later on some flowers that were lopsided, and on August 3 I noted the branch here photographed, in which the sepals have reverted to their original leafy character, clearly showing the pinnate margin characteristic of the species. The petals, too, although partly colored, were morphologically more like leaves than like the ordinary petals of a rose. Such phenomena are particularly common in cabbage roses; probably they are connected in some way with excess of nutrition, in many cases at least. Reversions such as the one photographed give striking proof, if any were needed, that flowers are merely modified leaves. (Fig. 11.) JOHN C. UHRLAUB, Glenbrook, Connecticut.

CORN AND MEN

The Interacting Influence of Heredity and Environment—Movements for Betterment of Men, or Corn, or Any Other Living Thing, One-sided Unless They Take Both Factors into Account.

ALBERT F. BLAKESLEE

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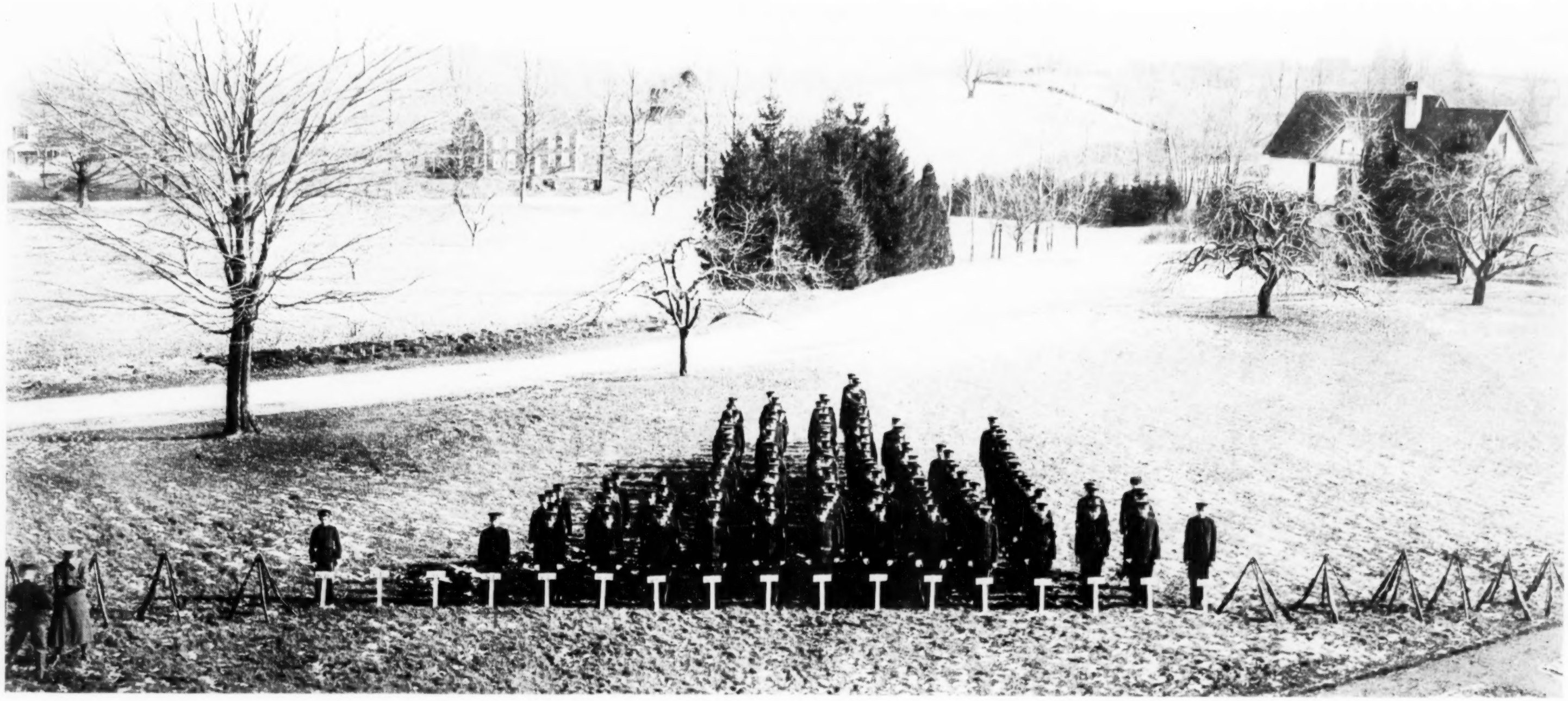
EUGENICS deals with racial improvement by means of heredity in contrast to the subject recently termed Euthenics which deals with improvement by means of the environment. These two influences —heredity and environment—together are responsible for the great diversity found in all living beings. It is this diversity in mankind that gives us our educated and our uneducated classes, our geniuses and our imbeciles, our lawmakers and our law-breakers. Successful and unsuccessful men, as well as successful and unsuccessful corn plants, are such because of the resultant influence of these two factors.

Both heredity and environment are always in play. Their distinction and their relative influence must be carefully estimated in any rational campaign for permanent social improvement. Our ideals and practice in social and religious justice, rewards and punishment, charity and education, are fundamentally dependent upon our estimate of the relative value of these two factors—environment and heredity. If one is born with inherent criminalistic and anti-social traits, the environment may be in no way responsible and can thus be neglected. Shall we, however, merely punish the individual or shall we attack the real cause of the crime—his heredity? On the other hand, if the criminal is made such by his environment, shall we confine our attention to the criminal and neglect the environment which has made him criminalistic?

A specific instance may make the questions clearer. In our past crusades against the social evil, we have too often sought legislation before investigation We have had recounted to us the pitiable struggle of the poorly paid wage earner, the influence of the saloon and of the dance hall. The downfall of fallen women has been attributed to these environmental conditions. If this is so, a cure for the evil would be simple, though difficult—namely, the removal of the bad environment. On the other hand, the family histories of these wayward girls have received little attention. Evidence, however, has been recently presented to indicate that moral waywardness is inherited in much the same manner as other mental defects—that moral deficiency runs in families. If heredity is the sole cause of the social evil, the remedy—the removal of the bad heredity—is obvious, but has not yet been seriously attempted. In endeavoring to heal this moral disease, need we attack more than one factor, or are these two—environment and heredity—of such influence that both require combatting? Such questions may bring home the need of knowledge of how these two fundamental factors act, before hasty attempts are made at social reform. A safe watchword is—Information before Legislation.

INTEREST IN GENETICS.

The comparatively recent discovery that knowledge of the laws of biology may be used in the improvement of cultivated plants and domesticated animals furnished the necessary human interest to bring the subject of Genetics into popular appreciation. The realization, further, that man himself is subject to the same laws of life as other animals has merely heightened the in-



Number of individuals in each rank	1	0	0	1	5	7	7	22	25	26	27	17	11	17	4	4	1
Heights in feet and inches to which ranks correspond	4:10	4:11	5.0	5:1	5:2	5:3	5:4	5:5	5:6	5:7	5:8	5:9	5:10	5:11	6:0	6:1	6:2

AN INTRODUCTION TO BIOMETRY

Company of students at Connecticut Agricultural College, grouped according to differences in height. The height of each rank, and the number of men in that rank, are shown in the figures below the photograph. The company constitutes what is technically known as a "population" grouped in "arrays of variates;" the middle array or row gives the median or average height of the population. If, now, a line be drawn connecting the upper ends of each row, and another line be drawn along the front rank to serve as a base, the resulting geometric figure forms a "scheme of distribution of variates" or more briefly, a "variability curve," since if the number of arrays were larger, the line joining their tops would form a perfectly smooth curve. The arrangement of homogeneous objects of any kind in such form as this is the first step in the study of variation by modern statistical methods, and on the study of variation much of the progress of genetics rests. (Fig. 12.)

terest which has been aroused by the application of scientific knowledge to plant and animal breeding. The most interesting study of mankind may be man, but in biology at least this study must make large use of the indirect method, employing plants and rapidly breeding animals for experimental purposes. The present article is to call attention to the fundamental differences between heredity and environment and to illustrate the subject by a comparison between the growth of corn and of man. The discussion will deal with a single comparatively simple characteristic—height. Something will be said about the manner in which a single character of this kind may vary among a group of individuals, and the influence of environment and heredity in bringing about these variations will be discussed.

Variation is universal among living organisms. It applies to individuals and parts of a single individual. A class of students after examining hundreds of apple leaves in the attempt to find two that are identical is willing to admit that no two leaves exist exactly alike. We are grateful indeed that in man no two persons have the same mental make-up. Differences in man's physical features as well as in his mental equipment are easily recognized and more readily analyzed. The relatively simple and obvious character of height may well serve for analysis. Each of the 175 students shown in Figure 12 was measured in his stocking feet and placed in the rank to which his height most nearly corresponded. Only one student was shorter than 5 ft. and only one could be placed higher than the 6 ft. 1 in. rank. The great majority are in the middle ranks 5 ft. 6 in. to 5 ft. 8 in. The extremes are rare, the average is common. Most of us are just average people, neither extremely tall nor short, fat nor slim, fast nor slow, rich nor poor.

Teachers know that differences in mental ability follow the same laws as differences in height. The majority of a class are average students. Few are unteachable and few gain the highest ranks that may be obtained.

If the ends of the ranks in the photograph were connected by a line we should have a typical curve of variability. Such a curve shows the distribution of the different heights in the company—the manner in which the individuals vary—but gives no definite clue to the causes of the differences which are found to exist.

WHY MEN GROW TALL.

Two general causes have been assigned to account for the differences in individuals brought to view by a variability curve, namely, environment and heredity. The first would assume that differences in height were due to differences in surroundings during growth; the tall boy is tall, it would be claimed, because he has been well nourished and cared for; the small boy is small because his growth has been checked by disease, accident, or insufficient nourishment. The second suggested cause, heredity, would assume that the differences in height are due to differences in the gifts of inheritance with which each individual began life; a tall boy is tall, it would be claimed, because tallness ran in his family, a short boy is short because his parents or less immediate ancestors were small of stature.

Differences in environment or in heredity, acting either alone or in combination, will be able to cause variation in a group of individuals. If these individuals are arranged in ranks according to the variations which they show in a single characteristic, they will present such a variability curve as is shown in Figure 12. Mere inspection of the curve, however, will not enable one to discover which factor is the predominant or exclusive cause of the variations. For this a study of the ancestry of the individuals and of the effect upon them of the various environmental conditions to which they are exposed will be necessary. A discussion of the corn plant will be appropriate in this connection.

In the Agricultural Botanic Garden at Storrs, Conn., a section is devoted to plots illustrating the laws of genetics. Differences in height and general vigor of plants are classified as due either to

THE INFLUENCE OF ENVIRONMENT ALONE

Corn of a single variety (Leaming dent): at the left, grown well spaced in hills, at the right badly crowded. The heredity of each plot of corn is the same; the striking differences in growth, and marked differences in reproductive capacity which are not seen in the photograph, are therefore solely due to environment. By avoiding the bad environment (*i.e.*, the crowded condition) the grower might have had corn in the plot on the right, just as big and vigorous as that on the left. If, however, he had planted some such variety as Tom Thumb pop corn on the right, it would have remained small no matter how good the environment provided, because of its heredity, which prevents it from being anything but small. The attempt to disentangle the influences of heredity and environment is one of the most perplexing problems in breeding, as in race betterment, but failure to attempt it leads to disastrous results. (Fig. 13.)

differences in external conditions under which they are grown, *i. e.*, to environment or to differences in their parentage, *i. e.*, to heredity. Figure 13 shows two plots of a tall variety of "Leaming" dent corn, which differ only in the environment to which they are exposed. Their ancestry is the same. In fact, the kernels with which both plots were planted came from the same ear. The difference in height between the tall plants on the left and the short plants on the right is due entirely to environment. The tall plants were planted far apart in hills, the short plants were crowded. Otherwise the conditions were similar. Crowding is obviously a bad environment which has dwarfed the plants. From another view point, abundant room for development may be considered a good environment which has stimulated the plants to unusual growth.

The differences between the two plots were more marked than one would judge from the photograph. At the edge of the crowded plot the effect of crowding was less intense and it is these plants on the edge which are seen and not the much smaller ones in the worse environment at the center. The crowding affected not only the height but also the reproductive organs. Except for the more favored plants on the margins which bore a few nubbins with scanty kernels, no ears were produced by the crowded plants. The tassels which bear the male organs were less

readily suppressed than the female ears. Crowding is a compound influence. Inability to obtain sufficient moisture or food constituents from the soil, an accumulation of poisonous excretions from the roots, the lack of sufficient light and air, may all be responsible in greater or less degree for the observed effect.

THE FORCE OF HEREDITY.

But while environment is a potent cause of variation, heredity is still more important. The diversity of a kitchen garden with its regular rows of beets, corn, beans and cabbage, is primarily due to the different hereditary characters bound up in the different kinds of seed that were planted. A cabbage seed will grow into a cabbage and not into a corn plant merely because its ancestors were cabbages and not corn. Not only are the different species of plants distinct on account of heredity, but the different cultivated varieties as well. In figure 15 is shown a plant of the Tom Thumb variety of pop corn beside a plant of the Leaming dent corn.

The Tom Thumb variety was grown in hills under the same favorable garden conditions as the tall Leaming corn already seen at the left in Figure 13. The environment is practically the same for the two forms, and the small size of the pop corn is due to the fact that the seed they were grown from was produced by a small-sized variety. It is perhaps fruitless to debate whether in corn environment is the more important or heredity. The latter has brought about the difference in height between the tall Leaming and the dwarf pop corn. The former is responsible for the effects of crowding shown in Figure 13.

But heredity must not be considered as effective only in the broader groups known as species and varieties. Each variety is doubtless a complex of many mingled types which have not been separated. Thus several races have been isolated from the tall Leaming corn of Figure 13. Of two such races picked out by the Illinois Experiment Station, one forms high ears, the other low ears. Likewise, from the same tall variety there have been separated out races that differ in the storage products in the kernels; one with a high, another with a low, oil content; one with a large proportion of protein, another poor in protein. The plants of these races differ thus chemically because of hereditary differences in their parentage. Heredity as a factor in the diversity in living forms is always present. When environment is the same, heredity is the sole cause of variation. Usually both are effective.

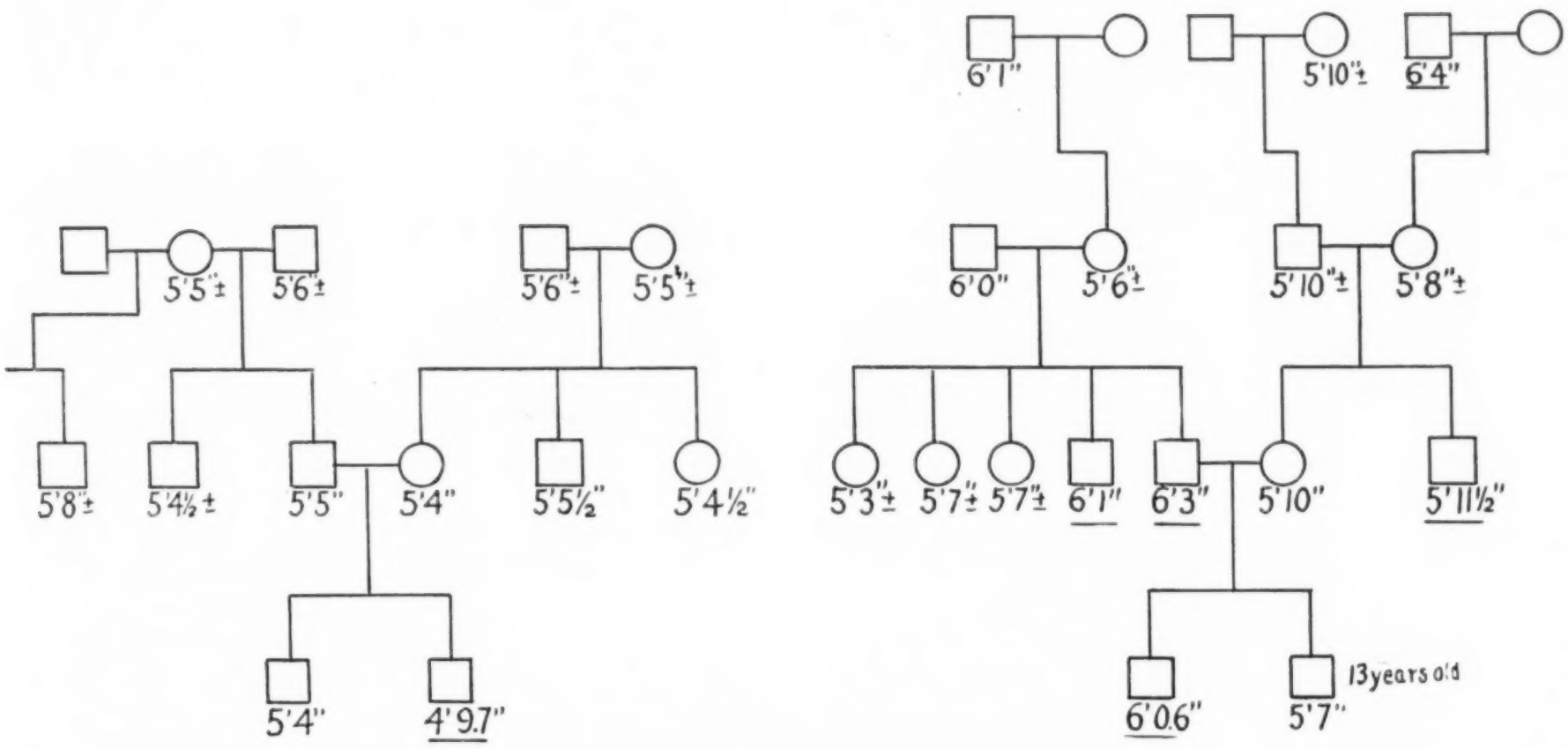
Let us return to the students shown in Figure 12 and see if we can discover which factor, heredity or environment, has been the more important in causing their differences in height. One from either extreme of the curve kindly consented to investigate the heights of his relatives with the results shown in Figure 14. The short student was 19 years old and the tall student was 17½. Squares indicate men and circles women, the figures underlined are stocking feet measurements. By estimating whether an uncle or a grandfather was shorter or taller than the father, a fair degree of accuracy was obtained of members of the family that could not be directly measured.

An inspection of the pedigrees shows that the small student comes from a short family. Except for a half uncle who was of about average height (5 ft. 8 in.), all his relatives of whom records could be obtained were undersized and none was over 5 ft. 6 in., which is about two inches below the average.

The tall student whose pedigree is given on the right has an entirely different ancestral history. Six footers run in both sides of the family. His great grandfather was reputed to be 6 ft. 4 in. in his stocking feet and the tallest and strongest man in his township. His brother, at present only 13 years old, is 5 ft. 7 in. and would now pass in his family as a relatively tall man had he been born into the other pedigree.

WHERE ENVIRONMENT ENTERS.

The data given confirm the more extensive evidence from other sources that heredity is the prime factor re-



WHY BOYS GROW SHORT OR TALL

Symbolical pedigrees of the two students shown at the ends of the line in fig. 12, and again shown in fig. 15. On the left, that of the shortest student (from the four feet, 10 inches rank); on the right, that of one of the tallest students (from the six ft., one in. rank). Squares represent men and circles women; figures underlined denote measurement in stocking feet. It is obvious from a comparison of the individuals in the ancestry of the two boys that the short student is short principally because his ancestors were short, while the tall one gains his height likewise from heredity. Bad environment might have stunted the latter; good environment could never had made the short student tall. (Fig. 14.)

sponsible for height differences in man. The cause is the same as that producing the tall Leaming dent and the short Tom Thumb pop varieties of corn. In illustration of this fact the students whose pedigrees have been given kindly consented to be photographed beside the appropriate variety of corn on either side of the nine foot pole shown in Figure 15.

It must not be assumed that environment has no influence at all upon man's stature. The question that the shorter student asked, if he was small because he had smoked since he was eight years old, was not entirely irrelevant despite the fact that the taller student had also used tobacco from his tenth year upward. Evidence shows that environment does have an effect upon man's physical as well as mental characteristics. Environment can influence the height of corn within certain limits. But the ancestry of the pop corn and of the student standing beside it foreordain both to a growth of limited proportions even under the best environment, while the Leaming corn and the boy of tall ancestry will both tend to grow tall despite a bad environment.

The facts that have been presented may appear familiar and the distinctions drawn trivial. But the distinctions lie at the base of all efforts for human betterment and are far from trivial in their significance. Although frequently confused by the similarity of their immediate effects, environment and heredity as causes are fundamentally different. Environment works upon the individual and its effects are transient. Heredity works upon the offspring and its effects are permanent, from generation to generation. Inherent characteristics only are transmitted. It has been generally assumed that characters acquired as a response to a good or to a bad environment are handed on to the next generation—that for example a man's college education will affect the mind of his newly-born children. Increasing knowledge has failed to support this assumption. "Acquired characters" seemingly cannot be handed on to one's descendants.

HEIGHT IN CORN AND MEN

Extremes in height from the array of students shown in fig. 12, photographed beside extreme varieties of corn which, like the students, owe their differences in height indisputably to heredity rather than to environment. No imaginable environmental influences could reverse the positions of these boys, or of these varieties of corn, the heredity in each case being what it is. Pedigrees of the two students are given in the preceding figure. (Fig. 15.)

In the past, environment has been assumed to be well nigh the sole cause of variation in the human race. The gratuitous pronouncement in the Declaration of Independence that all men are born equal has been accepted as literal inspiration. Recent discoveries of definite laws of inheritance have shown the dominant influence of heredity and the pendulum of opinion is swinging away from the side of environment. The enthusiasm, however, with which some would thoughtlessly rush into eugenics and eugenic legislation shows that they may stand in danger of having the new light blind their eyes to the influence of environment as a factor to be considered.

Man may be likened to the varieties of corn—good, bad and indifferent. The world around him, with opportunities, with education, may be compared to the garden plots of soil, also good, bad and indifferent.

In the garden of human life as in the garden of corn, success is the resultant complex of the two factors, environment and heredity.

NEW PUBLICATIONS

THE PROGRESS OF EUGENICS, by C. W. Saleeby, M. D. Pp. 253, price $1.50 net. Funk and Wagnalls Company, New York, 1914.

Few American eugenists are likely to define the scope of their science so broadly as does Dr. Saleeby, the active English propagandist whose earlier volume, Parenthood and Race Culture (1909), has led many readers to their first acquaintance with the ideals of race betterment. By including such problems as education and better housing for the poor, he opens questions whose importance no one will dispute, but which genetists in this country seem more and more inclined to leave in the hands of the avowed euthenist. To this extent, the content of Dr. Saleeby's book is likely to be slightly disappointing, while his acceptance of Lamarckian principles is certain also to call forth criticism. "The Progress of Eugenics" is an enthusiastic piece of special pleading, rather than a contribution to our knowledge of the science, but it is pretty certain to meet with a large and sympathetic audience, among whom it can hardly fail to be of real value in forwarding the interests of human genetics. Dr. Saleeby is rather pessimistic as to the immediate possibility of progress in the application of what he calls "positive eugenics," considering that "negative eugenics" must occupy most of the attention of the science for many years to come.

Children of the Tuberculous

Some of the effects of parental tuberculosis on the children are investigated by Dr. Wilhelm Weinberg, Sanitätsrat of Stuttgart, in his recently published book, "Die Kinder der Tuberkulosen," his material being several thousand families from the municipal statistics of Stuttgart. Dr. Weinberg, who is the principal exponent of the biometric method in German eugenics, asks and answers the following questions:

Is there, as is often believed, an excessive fecundity among the tuberculous? He finds the contrary to be the case, although the decrease is small.

Is there an unusually high death rate among children, one or both of whose parents died of tuberculosis? He finds that there is some increase, most of which is easily accounted for by infection and the fact that tuberculous stocks are frequently weak in other respects. He does not eliminate the influence of heredity but concludes that there is not yet a possibility of measuring its effect.